

**GRANT COUNTY LANDFILL COMPLEX
EPHRATA, WASHINGTON**

GRANT COUNTY
PUBLIC WORKS DEPARTMENT
EPHRATA, WASHINGTON

DIRECTOR OF PUBLIC WORKS
DEREK POHLE, PE

May 16, 2011



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ADVERTISEMENT FOR BIDS
LANDFILL SHOP COMPLEX
GRANT COUNTY PUBLIC WORKS DEPARTMENT
EPHRATA, WASHINGTON

Notice is hereby given that sealed bids, plainly marked "BID FOR LANDFILL SHOP COMPLEX, EPHRATA" will be received by the Board of County Commissioners of Grant County, at the Commissioners' Office, Grant County Courthouse, Ephrata, Washington, 98823 until 2:00 p.m. local time on Tuesday, the 28th day of June, 2011, and then publicly opened and read. Contract Documents may be examined at the following locations:

Grant County Public Works Department, Ephrata, Washington
Wenatchee Construction Council, Wenatchee, Washington
Tri-City Construction Council, Kennewick, Washington
Yakima Plan Center, Yakima, Washington
Spokane Regional Plan Center, Spokane, Washington
Associated Builders and Contractors, Spokane, Washington
AGC, Spokane, Washington
Construction Data, Seattle, Washington

Copies of the Contract Documents may be obtained by Prime Bidders and by bona fide Mechanical and Electrical Contractors from the office of Zeck Butler Architects, P.S., 421 West Riverside Ave., Suite 860, Spokane, Washington 99201-0433, (509) 456-8236, upon deposit of \$200.00 for each set. A maximum of two sets will be issued to each Prime Bidder and one set will be issued to each Mechanical and Electrical Contractor. Any such planholder, upon returning the Contract Documents promptly and in unmarked and unadulterated condition will be refunded the deposit.

Contract Documents may be purchased by anyone from Zeck Butler Architects, P.S., 421 West Riverside Ave., Suite 860, Spokane, Washington 99201-0433, (509) 456-8236. Purchasers of Contract Documents shall be responsible for verifying completeness of sets purchased and if any Addenda are issued. Purchases will not be refunded, nor will the purchaser be obligated to return the Documents.

Each proposal must be submitted on the prescribed forms and accompanied by a cashier's check, certified check or bid bond executed on the prescribed form, payable to Grant County in an amount not less than five (5%) percent of the amount of bid. No bidder may withdraw his bid after the hour set for opening thereof, unless contract award is delayed for a period exceeding 60 days.

A Pre-bid Conference will be held at the Public Works office, 124 Enterprise Street SE, Ephrata, Washington at 1:00 PM on Wednesday, June 15, 2011, with a visit to the project site to follow immediately thereafter. This conference is not mandatory, but is strongly recommended for all interested bidders.

The Grant County Board of Commissioners reserves the right to accept or reject any or all bids or to waive any informalities therein.

END OF ADVERTISEMENT FOR BIDS



AIA[®] Document A701[™] – 1997

Instructions to Bidders

for the following PROJECT:

(Name and location or address)

1009 - Grant County Landfill Complex
Ephrata, WA

THE OWNER:

(Name, legal status and address)

Grant County, Washington
Grant County Courthouse
P.O. Box 37
Ephrata, WA 98823

THE ARCHITECT:

(Name, legal status and address)

Zeck Butler Architects, P.S.
421 W. Riverside Ave., Suite 860
Spokane, WA 99201-0409

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ADDITIONS AND DELETIONS:

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

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

ARTICLE 1 DEFINITIONS

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

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

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

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

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

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

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

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

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

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 The Bidder by making a Bid represents that:

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

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

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

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

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 COPIES

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

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

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

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

§ 3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

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

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

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

§ 3.3 SUBSTITUTIONS

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

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

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

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

§ 3.4 ADDENDA

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

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

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

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

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 PREPARATION OF BIDS

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

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

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

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

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

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

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

§ 4.2 BID SECURITY

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

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

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

§ 4.3 SUBMISSION OF BIDS

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

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

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

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

§ 4.4 MODIFICATION OR WITHDRAWAL OF BID

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

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

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

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

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

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 OPENING OF BIDS

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

§ 5.2 REJECTION OF BIDS

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

§ 5.3 ACCEPTANCE OF BID (AWARD)

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

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

ARTICLE 6 POST-BID INFORMATION

§ 6.1 CONTRACTOR'S QUALIFICATION STATEMENT

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

§ 6.2 OWNER'S FINANCIAL CAPABILITY

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

§ 6.3 SUBMITTALS

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

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

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

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

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

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

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 BOND REQUIREMENTS

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

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

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

§ 7.2 TIME OF DELIVERY AND FORM OF BONDS

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

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

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

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

ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

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

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The "Instructions to Bidders", AIA Document A701, 1997 Edition, shall be modified as follows:

Modification of a portion of an article of the Instructions to Bidders by these "Supplementary Instructions to Bidders" shall apply to and supersede only those portions of the Instructions to Bidders to which reference is made in said modifications, and shall not be construed to nullify or change any other portion of that or other articles. In case of discrepancy between articles of the Instructions to Bidders and the Supplementary Instructions to Bidders, the latter shall take precedence.

ADD SUBPARAGRAPH 2.1.5 AS FOLLOWS

"2.1.5 The Bid includes all extant taxes, EXCEPT Washington State Sales Tax."

SUBPARAGRAPH 3.3.4

Add the following to the end of the paragraph (sentence): ", or in the best interests of the Owner as determined by the Architect".

SUBPARAGRAPH 4.4.1: REVISE TO READ AS FOLLOWS:

A bid may not be modified, withdrawn or canceled by the Bidder after the time set for opening thereof, unless the award for contract is delayed for a period exceeding sixty days (60) calendar days after date of opening of bids.

SUBPARAGRAPH 4.4.4: REVISE TO READ AS FOLLOWS:

The Contractor shall furnish to the Owner a Bid Security in the form of a bid bond or bank certified cashier's check, in the amount of five percent (5%) of the Total Base Bid amount, payable to **Grant County**.

PARAGRAPH 5.2

The paragraph is revised to read as follows: The Owner shall have the right to reject any or all Bid proposals when such rejection is in the best interest of the Owner. A Bid Proposal not accompanied with information required by the Bidding Documents or which is in any way incomplete or irregular is subject to rejection. The Owner reserves the right to waive any informalities and technicalities in bidding, accepting or rejecting bids.

PARAGRAPH 6.2

Delete paragraph 6.2 in its entirety.

****END OF SUPPLEMENTARY INSTRUCTIONS TO BIDDERS****

TO: Board of County Commissioners
Grant County, Washington

The undersigned hereby submits the following proposal:

BASE BID

Pursuant to and in compliance with Contract Documents, the undersigned hereby certifies that he/she has personally and carefully examined Advertisement for Bids, Instructions to Bidders, Supplementary Instructions to Bidders, Agreement Between Owner and Contractor, Conditions to the Contract (General and Special), Specifications (Division 1 thru 33), other referenced documents and other related documents, and Drawings entitled:

**GRANT COUNTY LANDFILL COMPLEX
Ephrata, Washington
GRANT COUNTY PUBLIC WORKS DEPARTMENT**

as prepared by Zeck Butler Architects, P.S., 421 West Riverside, Suite 860, Spokane, Washington, as well as the site and conditions affecting the work, and proposes to furnish all labor, materials and other services/costs necessary to complete the construction work in strict accordance with the above-named documents for the Base Bid sum of:

TOTAL BASE BID AMOUNT - including all Fees and Permits, except Building Permit and Plan Check fees, which will be paid by Owner.

_____ Dollars \$ _____
(Express in Words) (Express in Figures)

The undersigned agrees not to withdraw his/her proposal until the expiration of 60 days after date on which the proposals are due.

SALES TAX

The Base Bid amount DOES NOT include Washington State Sales Tax or Local Sales Tax.

TIME OF COMPLETION

The undersigned acknowledges and agrees to abide by all provisions of the "Time For Completion" section of the Special Conditions and provisions under Article 8 of the General Conditions of the Contract.

OFFICE OF RECORD

Undersigned designates his/her office of record to which notices may be mailed as

EXECUTION OF CONTRACT

If written notice of acceptance of this proposal is mailed, telegraphed, or delivered to undersigned within 60 days after date of opening of proposals, or any time thereafter before proposal is withdrawn, undersigned will, within 10 days after date of such mailing, telegraphing, or delivering of such notice, execute and deliver in form of agreement stated in this Project Manual.

ADDENDA

The undersigned acknowledges receipt of the following addenda:

Addendum Number	Dated

LIST OF GENERAL CONTRACTOR'S STAFF

The Owner requires that the bidder list the Project Superintendent and the Project Manager. Include resumes of both individuals with this Proposal.

Project Superintendent: _____

Project Manager: _____

BID BOND

Enclosed is a certified check, cashier's check or bid bond, in the amount of 5% of the Basic Bid, which the undersigned agrees to forfeit to the payee if the party is making this proposal fails to enter into contract with approved sureties within 10 days after contract is awarded to said party. Bid Bond shall contain all provisions of AIA Document A310, latest edition. Make check or bond payable to Grant County, Washington.

BIDDER INFORMATION AND SIGNATURE

Submitted By: _____ Date: _____
(Signature)

Proposing Firm*: _____

By: _____
(Type or Print Name)

Address: _____

City, State, Zip Code: _____

Telephone: _____ Fax: _____ E-Mail: _____

State of Washington Contractor's Licensing No.: _____

SEAL - (if Bid is by a corporation)

* Note: If firm is a corporation, write State of Incorporation under signature, and if a partnership, give full name of all partners.

SUBCONTRACTOR LIST

The following list identifies the Subcontractors with whom the Bidder, if awarded the contract, will subcontract for performance of the work of heating, ventilation and air conditioning, plumbing as described in Chapter 18.106 RCW, electrical as described in Chapter 19.28 RCW, and any other discipline as required by the Owner. The Bidder shall not list more than one Subcontractor for each category of work identified, unless Subcontractors vary with bid alternate(s), if any, in which case the Bidder must indicate which Subcontractor will be used for which alternate(s). **If a category of work will not be subcontracted, the Bidder must list itself.**

THIS LIST MUST BE SUBMITTED WITH TH BID, OR WITHIN ONE HOUR FOLLOWING THE OFFICIAL BID TIME. IF NOT SUBMITTED WITHIN THIS PERIOD, BID WILL BE DEEMED UNRESPONSIVE AND WILL NOT BE CONSIDERED FOR AWARD.

Base Bid Work		
Work Category	Subcontractor	Amount
Heating, Ventilation and Air Conditioning		
Plumbing		
Electrical		
Fuel Dispensing System		

END OF BID FORM

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General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

1009 - Grant County Landfill Complex
Ephrata, WA

THE OWNER:

(Name, legal status and address)

Grant County, Washington
Grant County Courthouse
P.O. Box 37
Ephrata, WA 98823

THE ARCHITECT:

(Name, legal status and address)

Zeck Butler Architects, P.S.
421 W. Riverside Ave., Suite 860
Spokane, WA 99201-0409

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ADDITIONS AND DELETIONS:

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

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

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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 requirements.

§ 1.1.2 THE CONTRACT

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

§ 1.1.3 THE WORK

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

§ 1.1.4 THE PROJECT

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

§ 1.1.5 THE DRAWINGS

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

§ 1.1.6 THE SPECIFICATIONS

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

§ 1.1.7 INSTRUMENTS OF SERVICE

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

§ 1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

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

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

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

§ 1.3 CAPITALIZATION

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

§ 1.4 INTERPRETATION

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

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

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

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them 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 material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER

§ 2.1 GENERAL

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

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

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the

portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 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.

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

§ 2.2.4 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.

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

§ 2.3 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.

§ 2.4 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 written 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 deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 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 obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

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

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, 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.

§ 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 make 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 as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required 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.

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

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

§ 3.5 WARRANTY

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.

§ 3.6 TAXES

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

§ 3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

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

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

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

§ 3.7.4 **Concealed or Unknown Conditions.** If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may proceed 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.

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§ 3.8 ALLOWANCES

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 SUPERINTENDENT

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

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

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

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

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

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, 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 maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work 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 the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

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

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

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

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

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

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and

completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, 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. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 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, and 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 and patching shall be restored to the condition existing prior to the cutting, fitting and 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 such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove 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 Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK

The Contractor shall provide the Owner and Architect 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 such 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 the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), 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 which would otherwise exist as to a party or person described in this Section 3.18.

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§ 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 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.

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

§ 4.2 ADMINISTRATION OF THE CONTRACT

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

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 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 report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. 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 FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect's 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 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

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

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

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

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made 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 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.

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

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply 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 previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

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

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

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

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; 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 such 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 Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

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

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the 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, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY

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

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

§ 6.2.3 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 the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

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

§ 6.3 OWNER'S RIGHT TO CLEAN UP

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 GENERAL

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

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

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

§ 7.2 CHANGE ORDERS

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

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

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

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

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

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

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.7.

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

§ 7.3.5 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.

§ 7.3.6 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.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount

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for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

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

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

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

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

§ 7.4 MINOR CHANGES IN THE WORK

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

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

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

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

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

§ 9.2 SCHEDULE OF VALUES

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

§ 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. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

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

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

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

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

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encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.4 CERTIFICATES FOR PAYMENT

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

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Architect may 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 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 the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 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 material or equipment suppliers 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 Architect will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS

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

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

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

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment 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 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, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment 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 and 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, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT

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

§ 9.8 SUBSTANTIAL COMPLETION

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

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

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

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

§ 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 such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such 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 as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

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

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

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

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

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

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

§ 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; or
- .3 terms of special warranties required by the Contract Documents.

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

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

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

§ 10.2 SAFETY OF PERSONS AND PROPERTY

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

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

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

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

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in 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, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

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

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

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY

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

§ 10.3 HAZARDOUS MATERIALS

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. 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 report the condition to the Owner and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such 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 in the amount of the Contractor's reasonable additional costs of shut-down, 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 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 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 indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance 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 indemnify 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 LIABILITY INSURANCE

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

- .1 Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- .2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- .3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- .4 Claims for damages insured by usual personal injury liability coverage;
- .5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- .6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- .7 Claims for bodily injury or property damage arising out of completed operations; and
- .8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

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

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

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

§ 11.2 OWNER'S LIABILITY INSURANCE

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

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in 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.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, 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 and Contractor's services and expenses required as a result of such insured loss.

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

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

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

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

§ 11.3.2 BOILER AND MACHINERY INSURANCE

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

§ 11.3.3 LOSS OF USE INSURANCE

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

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

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, 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, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

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

§ 11.3.7 WAIVERS OF SUBROGATION

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

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

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

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

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

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

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. 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 2.4.

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

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

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

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors 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 except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 SUCCESSORS AND ASSIGNS

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

§ 13.3 WRITTEN NOTICE

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

§ 13.4 RIGHTS AND REMEDIES

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

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

§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work 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 (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by

such failure including those of repeated procedures and compensation for the Architect's services and expenses shall be at the Contractor's expense.

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

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

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

§ 13.6 INTEREST

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

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time 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 13.7.

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 or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires 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 promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

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

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written 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 for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

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

- .1 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 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 as described in 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 written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; 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 Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

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, 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.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the 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 must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

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. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

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

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

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

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

§ 15.1.6 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 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, 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 arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

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

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

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such 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 an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, 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 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

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

§ 15.3.3 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. 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 Either party, at its sole discretion, 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 Either party, at its sole discretion, 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 the Owner and Contractor under this Agreement.

SPECIAL CONDITIONS

1. GENERAL

All applicable Federal, State and Local codes, ordinances and regulations shall apply to this Work. Special attention is directed to Title 39 of RCW, "Public Contracts and Indebtedness". Certain parts of Title 39 are addressed in these Special Conditions, but all applicable provisions of Title 39 shall be complied with whether or not addressed herein.

2. CONTRACTOR'S LICENSE

Contractor for this Work shall be licensed as required by the State of Washington.

3. TIME FOR COMPLETION

All Work in this Contract shall be substantially complete within **240** calendar days from the Notice to Proceed. Extensions may be granted due to conditions beyond the control of the Contractor or his Subcontractors. Validity of such conditions shall be determined solely by the Architect.

4. COMPLETION SCHEDULE

Time is of the essence in the commencement, continuation, and completion of the Work. Contractor shall prepare and submit for Owner's approval a construction schedule for Final completion of the Work. The construction schedule shall not exceed the time limits specified in the Contract.

The Contractor will update the schedule and the Final Completion dates for each Phase of the Work for Owner's approval with each construction draw request. Extensions for Final Completion of any Phase of the Work, based on adverse weather or other *force majeure* events, shall be made only through written change orders prepared by Contractor and submitted to Owner, for its approval, within five (5) days of such delay. In the case of weather delays, Owner will approve only those change orders caused by abnormal weather conditions not reasonably anticipated using 50-year weather data (e.g., rain, snow and cold weather not normally anticipated at the time of year in which the Work is to be completed).

5. SUBSTANTIAL COMPLETION

The Project shall be deemed to have achieved "Substantial Completion" when all of the following have occurred:

- a. The Project architect has issued a Certificate of Substantial Completion (AIA Form G704 or the equivalent);
- b. The Project or, in the case of a phased project, specific units in a particular phase, are capable of being beneficially occupied for their intended use; and
- c. A certificate of occupancy or the equivalent governmental permit has been issued that allows the Project or the units in a particular Phase, as applicable, to be leased and occupied.

6. LIQUIDATED DAMAGES

Liquidated damages of \$500.00 per day shall be paid by the Contractor to the Owner for each day beyond Time for Completion that construction is required for completion of the Work. Completion shall be considered the date on which the Architect issues a Certificate of Substantial Completion. Substantial Completion shall be as determined solely by the Architect.

7. FINAL COMPLETION

The Project shall be deemed to have achieved "Final Completion" when all of the items set forth in Section 5 hereof have occurred and all of the following additional items have occurred:

- a. The Project architect has issued a Final Certificate for Payment;
- b. All punch list items have been completed to the satisfaction of the Project architect and Owner; and
- c. Owner has received full and final lien waivers from the Contractor and all subcontractors and material suppliers, irrespective of tier, together with a Contractor's affidavit or sworn statement covering all Work for the Project.

8. RETAINAGE

In connection with each disbursement on account of any hard cost item due, an amount (the "Retainage") equal to five percent (5%) of that portion of the Contract sum allocable to each portion of the Work completed shall be deducted from each progress payment under the Contract. The Retainage, less any deductions from the Contract sum provided for under the Contract, shall be paid upon Final Completion of the Work. Notwithstanding the foregoing, if a portion of the Work cannot be completed because weather conditions prevent the completion of certain exterior work (e.g., landscaping or exterior pavements) ("Exterior Items"), Retainage shall be disbursed less one hundred fifty percent (150%) of the sum the architect reasonably determines to be allocable to the completion of the Exterior Items. If Contractor fails to complete the Exterior Items by a mutually agreed upon date, Owner may use the Retainage to complete such Items and the Contractor forfeits all rights to such Retainage.

9. BOND

The Contractor shall deliver to the Owner a good and sufficient bond with a surety company as surety, in an amount equal to the full contract price, conditioned that such person or persons shall faithfully perform all the provisions of such contract and pay all laborers, mechanics and subcontractors and materialmen, and all persons who shall supply such person or persons, or subcontractors, with provisions and supplies for the carrying on of such work. Bond shall be to **Grant County, Washington.**

10. SPECIAL PAYMENT REQUIREMENTS

Before payment is made to the Contractor of any sums due under this Contract, the Owner must receive from the Contractor and each Subcontractor a copy of "Statement of Intent to Pay Prevailing Wages", approved by the Washington State Department of Labor and Industries.

Upon completion of this Contract, the Owner must receive from the Contractor and each Subcontractor a copy of "Affidavit of Wages Paid" approved by the State Department of Labor and Industries. In addition, the Owner must receive from the Contractor a copy of "Request for Release" approved by the State Department of Labor and Industries. These affidavits will be required before any funds retained are released to the Contractor. Forms may be obtained from the Department of Labor and Industries. A fee for each "Statement of Intent to Pay Prevailing Wages" and "Affidavit of Wages Paid" is required to accompany each form submitted to the Department of Labor and Industries. The Contractor is responsible for payment of these fees and shall make all applications directly to the Department of Labor and Industries.

11. WAGE RATES

This project is subject to State prevailing wage rates. No workmen, laborer, or mechanical employed in the performance of any part of this Contract shall be paid less than the prevailing rate of wage as determined by the Industrial Statistician of the Department of Labor and Industries and bound herein.

****END OF SPECIAL CONDITIONS****

Prevailing Wage Rates

The following Washington state prevailing wage rates have been included for convenience. It remains the contractor's responsibility to verify that current rates have been used. Rates can be viewed on Washington State Department of L & I website.

State of Washington
 Department of Labor & Industries
 Prevailing Wage Section - Telephone 360-902-5335
 PO Box 44540, Olympia, WA 98504-4540

Washington State Prevailing Wage

The PREVAILING WAGES listed here include both the hourly wage rate and the hourly rate of fringe benefits. On public works projects, worker's wage and benefit rates must add to not less than this total. A brief description of overtime calculation requirements are provided on the Benefit Code Key.

Journey Level Prevailing Wage Rates for the Effective Date: 5/25/2011

<u>County</u>	<u>Trade</u>	<u>Job Classification</u>	<u>Wage</u>	<u>Holiday</u>	<u>Overtime</u>	<u>Note</u>
Grant	<u>Asbestos Abatement Workers</u>	Journey Level	\$20.79		<u>1</u>	
Grant	<u>Boilermakers</u>	Journey Level	\$59.69	<u>5N</u>	<u>1C</u>	
Grant	<u>Brick Mason</u>	Journey Level	\$40.03	<u>5A</u>	<u>1M</u>	
Grant	<u>Building Service Employees</u>	Janitor	\$12.56		<u>1</u>	
Grant	<u>Building Service Employees</u>	Shampooer	\$11.14		<u>1</u>	
Grant	<u>Building Service Employees</u>	Waxer	\$8.89		<u>1</u>	
Grant	<u>Building Service Employees</u>	Window Cleaner	\$9.14		<u>1</u>	
Grant	<u>Cabinet Makers (In Shop)</u>	Journey Level	\$8.67		<u>1</u>	
Grant	<u>Carpenters</u>	Carpenters	\$37.16	<u>5A</u>	<u>1B</u>	<u>8N</u>
Grant	<u>Cement Masons</u>	Journey Level	\$35.85	<u>7B</u>	<u>1N</u>	
Grant	<u>Divers & Tenders</u>	Diver	\$80.48	<u>5A</u>	<u>1B</u>	<u>8A</u>
Grant	<u>Divers & Tenders</u>	Diver on Standby	\$45.79	<u>5A</u>	<u>1B</u>	
Grant	<u>Divers & Tenders</u>	Diver Tender	\$44.79	<u>5A</u>	<u>1B</u>	
Grant	<u>Divers & Tenders</u>	Diving Master	\$54.23	<u>5A</u>	<u>1B</u>	
Grant	<u>Divers & Tenders</u>	Surface RCV & ROV Operator	\$44.79	<u>5A</u>	<u>1B</u>	
Grant	<u>Divers & Tenders</u>	Surface RCV & ROV Operator Tender	\$43.04	<u>5A</u>	<u>1B</u>	
Grant	<u>Dredge Workers</u>	Assistant Engineer	\$47.09	<u>5D</u>	<u>1N</u>	<u>8D</u>
Grant	<u>Dredge Workers</u>	Assistant Mate(deckhand)	\$46.58	<u>5D</u>	<u>1N</u>	<u>8D</u>
Grant	<u>Dredge Workers</u>	Boatmen	\$47.09	<u>5D</u>	<u>1N</u>	<u>8D</u>
Grant	<u>Dredge Workers</u>	Engineer Oiler	\$47.14	<u>5D</u>	<u>1N</u>	<u>8D</u>
Grant	<u>Dredge Workers</u>	Leverman, Hydraulic	\$48.71	<u>5D</u>	<u>1N</u>	<u>8D</u>
Grant	<u>Dredge Workers</u>	Maintenance	\$46.58	<u>5D</u>	<u>1N</u>	<u>8D</u>
Grant	<u>Dredge Workers</u>	Mates	\$47.09	<u>5D</u>	<u>1N</u>	<u>8D</u>
Grant	<u>Dredge Workers</u>	Oiler	\$46.58	<u>5D</u>	<u>1N</u>	<u>8D</u>
Grant	<u>Drywall Applicator</u>	Journey Level	\$37.16	<u>5A</u>	<u>1B</u>	<u>8N</u>
Grant	<u>Drywall Tapers</u>	Journey Level	\$31.79	<u>7E</u>	<u>1P</u>	
Grant	<u>Electrical Fixture Maintenance</u>	Journey Level	\$24.88		<u>1</u>	

	<u>Workers</u>				
Grant	<u>Electricians - Inside</u>	Cable Splicer	\$52.31	<u>7H</u>	<u>1E</u>
Grant	<u>Electricians - Inside</u>	Construction Stock Person	\$26.34	<u>7H</u>	<u>1D</u>
Grant	<u>Electricians - Inside</u>	Journey Level	\$48.72	<u>7H</u>	<u>1E</u>
Grant	<u>Electricians - Motor Shop</u>	Craftsman	\$15.37		<u>1</u>
Grant	<u>Electricians - Motor Shop</u>	Journey Level	\$14.69		<u>1</u>
Grant	<u>Electricians - Powerline Construction</u>	Cable Splicer	\$63.04	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Certified Line Welder	\$57.61	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Groundperson	\$41.06	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Head Groundperson	\$43.33	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Heavy Line Equipment Operator	\$57.61	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Jackhammer Operator	\$43.33	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Journey Level Lineperson	\$57.61	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Line Equipment Operator	\$48.64	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Pole Sprayer	\$57.61	<u>5A</u>	<u>4A</u>
Grant	<u>Electricians - Powerline Construction</u>	Powderperson	\$43.33	<u>5A</u>	<u>4A</u>
Grant	<u>Electronic Technicians</u>	Journey Level	\$17.31		<u>1</u>
Grant	<u>Elevator Constructors</u>	Mechanic	\$67.91	<u>7D</u>	<u>4A</u>
Grant	<u>Elevator Constructors</u>	Mechanic In Charge	\$73.87	<u>7D</u>	<u>4A</u>
Grant	<u>Fabricated Precast Concrete Products</u>	Journey Level - In-Factory Work Only	\$9.96		<u>1</u>
Grant	<u>Fence Erectors</u>	Fence Erector	\$13.80		<u>1</u>
Grant	<u>Fence Erectors</u>	Fence Laborer	\$11.60		<u>1</u>
Grant	<u>Flaggers</u>	Journey Level	\$30.31	<u>7B</u>	<u>1M</u>
Grant	<u>Glaziers</u>	Journey Level	\$24.39	<u>7E</u>	<u>1K</u>
Grant	<u>Heat & Frost Insulators And Asbestos Workers</u>	Journey Level	\$45.77		<u>1</u>
Grant	<u>Heating Equipment Mechanics</u>	Journey Level	\$27.67		<u>1</u>
Grant	<u>Hod Carriers & Mason Tenders</u>	Journey Level	\$33.69	<u>7B</u>	<u>1M</u>
Grant	<u>Industrial Engine And Machine Mechanics</u>	Journey Level	\$15.65		<u>1</u>
Grant	<u>Industrial Power Vacuum Cleaner</u>	Journey Level	\$9.24		<u>1</u>
Grant	<u>Inland Boatmen</u>	Journey Level	\$8.67		<u>1</u>
Grant	<u>Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control</u>	Cleaner Operator, Foamer Operator	\$9.73		<u>1</u>
Grant	<u>Inspection/Cleaning/Sealing Of</u>	Grout Truck Operator	\$11.48		<u>1</u>

	<u>Sewer & Water Systems By Remote Control</u>					
Grant	<u>Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control</u>	Head Operator	\$12.78		<u>1</u>	
Grant	<u>Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control</u>	Technician	\$8.67		<u>1</u>	
Grant	<u>Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control</u>	Tv Truck Operator	\$10.53		<u>1</u>	
Grant	<u>Insulation Applicators</u>	Journey Level	\$37.16	<u>5A</u>	<u>1B</u>	<u>8N</u>
Grant	<u>Ironworkers</u>	Journeyman	\$50.69	<u>7N</u>	<u>1O</u>	
Grant	<u>Laborers</u>	Air And Hydraulic Track Drill	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Asphalt Raker	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Asphalt Roller, Walking	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Brick Pavers	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Brush Hog Feeder	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Brush Machine	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Caisson Worker, Free Air	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Carpenter Tender	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Cement Finisher Tender	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Cement Handler	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Chain Saw Operator & Faller	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Clean-up Laborer	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Compaction Equipment	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Concrete Crewman	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Concrete Saw, Walking	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Concrete Signalman	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Concrete Stack	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Confined Space Attendant	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Crusher Feeder	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Demolition	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Demolition Torch	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Dope Pot Fireman, Non-mechanical	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Driller Helper (when Required To Move & Position Machine)	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Drills With Dual Masts	\$33.23	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Dry Stack Walls	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Dumpman	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Erosion Control Laborer	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Final Detail Cleanup (i.e., Dusting, Vacuuming, Window Cleaning; Not Construction Debris Cleanup)	\$30.31	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Firewatch	\$32.41	<u>7B</u>	<u>1M</u>	

Grant	<u>Laborers</u>	Form Cleaning Machine Feeder, Stacker	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Form Setter, Paving	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	General Laborer	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Grade Checker	\$34.94	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Grout Machine Header Tender	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Guard Rail	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Gunite	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Hazardous Waste Worker (level A)	\$33.23	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Hazardous Waste Worker (level B)	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Hazardous Waste Worker (level C)	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Hazardous Waste Worker (level D)	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Hdpe Or Similar Liner Installer	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	High Scaler	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Jackhammer Operator Miner, Class "b"	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Laser Beam Operator	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Miner, Class "a"	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Miner, Class "c"	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Miner, Class "d"	\$33.23	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Monitor Operator, Air Track Or Similar Mounting	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Mortar Mixer	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Nipper	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Nozzleman	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Nozzleman, Water (to Include Fire Hose), Air Or Steam	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Pavement Breaker, 90 Lbs. & Over	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Pavement Breaker, Under 90 Lbs.	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Pipelayer	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Pipelayer, Corrugated Metal Culvert And Multi-plate	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Pipewrapper	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Plasterer Tenders	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Pot Tender	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Powderman	\$34.60	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Powderman Helper	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Power Buggy Operator	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Power Tool Operator, Gas, Electric, Pneumatic	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Railroad Equipment, Power	\$32.68	<u>7B</u>	<u>1M</u>	

		Driven, Except Dual Mobile				
Grant	<u>Laborers</u>	Railroad Power Spiker Or Puller, Dual Mobile	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Remote Equipment Operator	\$33.23	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Remote Equipment Operator (i.e. Compaction And Demolition)	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Rigger/signal Person	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Riprap Person	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Rodder & Spreader	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Sandblast Tailhoseman	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Scaffold Erector, Wood Or Steel	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Stake Jumper	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Structural Mover	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Tailhoseman (water Nozzle)	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Timber Bucker & Faller (by Hand)	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Track Laborer (rr)	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Trencher, Shawnee	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Trenchless Technology Technician	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Truck Loader	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Tugger Operator	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Vibrators, All	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Wagon Drills	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Water Pipe Liner	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Welder, Electric, Manual Or Automatic (hdpe Or Similar Pipe And Liner)	\$33.23	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Well-point Person	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers</u>	Wheelbarrow, Power Driven	\$32.68	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers - Underground Sewer & Water</u>	General Laborer & Topman	\$32.41	<u>7B</u>	<u>1M</u>	
Grant	<u>Laborers - Underground Sewer & Water</u>	Pipe Layer	\$32.95	<u>7B</u>	<u>1M</u>	
Grant	<u>Landscape Construction</u>	Irrigation Or Lawn Sprinkler Installers	\$9.00		<u>1</u>	
Grant	<u>Landscape Construction</u>	Landscape Equipment Operators Or Truck Drivers	\$9.00		<u>1</u>	
Grant	<u>Landscape Construction</u>	Landscaping Or Planting Laborers	\$9.00		<u>1</u>	
Grant	<u>Lathers</u>	Journey Level	\$37.16	<u>5A</u>	<u>1B</u>	<u>8N</u>
Grant	<u>Marble Setters</u>	Journey Level	\$40.03	<u>5A</u>	<u>1M</u>	
Grant	<u>Metal Fabrication (In Shop)</u>	Fitter	\$10.79		<u>1</u>	
Grant	<u>Metal Fabrication (In Shop)</u>	Painter	\$8.67		<u>1</u>	
Grant	<u>Metal Fabrication (In Shop)</u>	Welder	\$10.79		<u>1</u>	

Grant	<u>Millwright</u>	Journey Level	\$43.10	<u>5A</u>	<u>1B</u>	<u>8N</u>
Grant	<u>Modular Buildings</u>	Journey Level	\$8.67		<u>1</u>	
Grant	<u>Painters</u>	Journey Level	\$34.87	<u>6Z</u>	<u>2B</u>	
Grant	<u>Pile Driver</u>	Journey Level	\$38.10	<u>5A</u>	<u>1B</u>	<u>8N</u>
Grant	<u>Plasterers</u>	Journey Level	\$10.00		<u>1</u>	
Grant	<u>Playground & Park Equipment Installers</u>	Journey Level	\$8.67		<u>1</u>	
Grant	<u>Plumbers & Pipefitters</u>	Journey Level	\$27.67		<u>1</u>	
Grant	<u>Power Equipment Operators</u>	A-frame Truck (2 Or More Drums)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	A-frame Truck (single Drum)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Asphalt Plant Operator	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Assistant Plant Operator, Fireman Or Pugmixer (asphalt)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Assistant Refrigeration Plant & Chiller Operator (over 1000 Ton)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Assistant Refrigeration Plant (under 1000 Ton)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Automatic Subgrader (ditches & Trimmers)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Backfillers (cleveland & Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Backhoe & Hoe Ram (under 3/4 Yd.)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Backhoe (45,000 Gw & Under)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Backhoe (45,000 Gw To 110,000 Gw)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Backhoe (over 110,000 Gw)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Backhoes & Hoe Ram (3 Yds & Over)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Backhoes & Hoe Ram (3/4 Yd. To 3 Yd.)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Bagley Or Stationary Scraper	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Batch & Wet Mix Operator (multiple Units, 2 & Incl. 4)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Batch Plant & Wet Mix Operator, Single Unit (concrete)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Batch Plant (over 4 Units)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Belt Finishing Machine	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Belt Loader (kocal Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Belt-crete Conveyors With Power Pack Or Similar	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Bending Machine	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Bit Grinders	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Blade (finish & Bluetop), Automatic, Cmi, Abc, Finish	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>

		Athey & Huber & Similar When Used As Automatic				
Grant	<u>Power Equipment Operators</u>	Blade Operator (motor Patrol & Attachments)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Blower Operator (cement)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Boat Operator	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Bob Cat (skid Steer)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Bolt Threading Machine	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Boom Cats (side)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Boring Machine (earth)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Boring Machine (rock Under 8" Bit) (quarry Master, Joy Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Bump Cutter (wayne, Saginaw Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Cableway Controller (dispatcher)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Cableway Operators	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Canal Lining Machine (concrete)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Carrydeck & Boom Truck (under 25 Tons)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Cement Hog	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Chipper (without Crane) Cleaning & Doping Machine (pipeline)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Clamshell, Dragline	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Compactor (self-propelled With Blade)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Compressor (2000 Cfm Or Over, 2 Or More, Gas Diesel Or Electric Power)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Compressors (under 2000 Cfm, Gas, Diesel Or Electric Power)	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Concrete Cleaning / Decontamination Machine Operator	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Concrete Pump Boon Truck	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Concrete Pumps (squeeze-crete, Flow-crete, Whitman & Similar)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Concrete Saw (multiple Cut)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Concrete Slip Form Paver	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Conveyor Aggregate Delivery Systems (c.a.d.)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Crane Oiler- Driver (cdl Required) & Cable Tender, Mucking Machine	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Cranes (25 Tons & Under), All	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>

		Attachments Incl. Clamshell, Dragline				
Grant	<u>Power Equipment Operators</u>	Cranes (25 Tons To And Including 45 Tons), All Attachments Incl. Clamshell, Dragline	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Cranes (45 Tons To 85 Tons), All Attachments Incl. Clamshell And Dragline	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Cranes (85 Tons & Over) And All Climbing, Overhead, Rail & Tower. All Attachments Incl.	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Crusher Feeder	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Crusher, Grizzle & Screening Plant Operator	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Curb Extruder (asphalt Or Concrete)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Deck Engineer	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Deck Hand	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Derricks & Stifflegs (65 Tons & Over)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Derricks & Stifflegs (under 65 Tons)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Distributor Leverman	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Ditch Witch Or Similar	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Dope Pots (power Agitated	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Dozer / Tractor (up To D-6 Or Equivalent) And Traxcavator	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Dozer / Tractors (d-6 & Equivalent & Over)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Dozer, 834 R/t & Similar	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Drill Doctor	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Driller Licensed	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Drillers Helper	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Drilling Equipment (8" Bit & Over) (robbins, Reverse Circulation & Similar)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Drills (churn, Core, Calyx Or Diamond)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Elevating Belt (holland Type)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Elevating Belt-type Loader (euclid, Barber Green & Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Elevating Grader-type Loader (dumor, Adams Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Elevator Hoisting Materials	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Equipment Serviceman, Greaser & Oiler	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Fireman & Heater Tender	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>

Grant	<u>Power Equipment Operators</u>	Fork Lift Or Lumber Stacker, Hydra-life & Similar	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Generator Plant Engineers (diesel Or Electric)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Gin Trucks (pipeline)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Grade Checker	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Gunite Combination Mixer & Compressor	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	H.d. Mechanic	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	H.d. Welder	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Helicopter Pilot	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Helper, Mechanic Or Welder, H.D	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Hoe Ram	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Hoist (2 Or More Drums Or Tower Hoist)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Hoist, Single Drum	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Hydraulic Platform Trailers (goldhofer, Shaurerly And Similar)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Hydro-seeder, Mulcher, Nozzleman	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Lime Batch Tank Operator (recycle Train)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Lime Brain Operator (recycle Train)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Loader (360 Degrees Revolving Koehring Scooper Or Similar)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Loader Operator (front-end & Overhead, 4 Yds. Incl. 8 Yds.)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Loaders (bucket Elevators And Conveyors)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Loaders (overhead & Front-end, Over 8 Yds. To 10 Yds.)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Loaders (overhead & Front-end, Under 4 Yds.. R/t)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Loaders (overhead And Front-end, 10 Yds. & Over)	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Locomotive Engineer	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Longitudinal Float	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Master Environmental Maintenance Technician	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Mixer (portable - Concrete)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Mixermobile	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Mobile Crusher Operator (recycle Train)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Mucking Machine	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Multiple Dozer Units With	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>

		Single Blade				
Grant	<u>Power Equipment Operators</u>	Pavement Breaker, Hydra-hammer & Similar	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Paving (dual Drum)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Paving Machine (asphalt And Concrete)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Piledriving Engineers	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Plant Oiler	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Posthole Auger Or Punch	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Power Broom	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Pump (grout Or Jet)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Pumpman	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Quad-track Or Similar Equipment	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Railroad Ballast Regulation Operator (self-propelled)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Railroad Power Tamper Operator (self-propelled)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Railroad Tamper Jack Operator (self-propelled)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Railroad Track Liner Operator (self-propelled)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Refrigeration Plant Engineer (1000 Tons & Over)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Refrigeration Plant Engineer (under 1000 Ton)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Rollerman (finishing Asphalt Pavement)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Rollers, All Types On Subgrade, Including Seal And Chip Coating (farm Type, Case, John Deere And Similar, or Compacting Vibrator), Except When Pulled B	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Roto Mill (pavement Grinder)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Rotomill Groundsman	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Rubber-tired Scrapers (multiple Engine With Three Or More Scrapers)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Rubber-tired Skidders (r/t With Or Without Attachments)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Scrapers, All, Rubber-tired	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Screed Operator	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Shovels (3 Yds. & Over)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Shovels (under 3 Yds.)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Signalman (whirleys, Highline, Hammerheads Or Similar)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Soil Stabilizer (p & H Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>

Grant	<u>Power Equipment Operators</u>	Spray Curing Machine (concrete)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Spreader Box (self-propelled)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Spreader Machine	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Steam Cleaner	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Straddle Buggy (ross & Similar On Construction Job Only)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Surface Heater & Planer Machine	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Tractor (farm Type R/t With Attachments, Except Backhoe)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Traverse Finish Machine	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Trenching Machines (7 Ft. Depth & Over)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Trenching Machines (under 7 Ft. Depth Capacity)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Tug Boat Operator	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Tugger Operator	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Turnhead (with Re-screening)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Turnhead Operator	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Ultra High Pressure Waterjet Cutting Tool System Operator, (30,000 Psi)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Vactor Guzzler, Super Sucker	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Vacuum Blasting Machine Operator	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Vacuum Drill (reverse Circulation Drill Under 8" Bit)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Welding Machine	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators</u>	Whirleys & Hammerheads, All	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	A-frame Truck (2 Or More Drums)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	A-frame Truck (single Drum)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	Asphalt Plant Operator	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	Assistant Plant Operator, Fireman Or Pugmixer (asphalt)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	Assistant Refrigeration Plant & Chiller Operator (over 1000 Ton)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	Assistant Refrigeration Plant (under 1000 Ton)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	Automatic Subgrader (ditches & Trimmers)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	Backfillers (cleveland & Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-Underground Sewer & Water</u>	Backhoe & Hoe Ram (under 3/4 Yd.)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>

Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Backhoe (45,000 Gw & Under)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Backhoe (45,000 Gw To 110,000 Gw)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Backhoe (over 110,000 Gw)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Backhoes & Hoe Ram (3 Yds & Over)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Backhoes & Hoe Ram (3/4 Yd. To 3 Yd.)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Bagley Or Stationary Scraper	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Batch & Wet Mix Operator (multiple Units, 2 & Incl. 4)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Batch Plant & Wet Mix Operator, Single Unit (concrete)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Batch Plant (over 4 Units)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Belt Finishing Machine	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Belt Loader (kocal Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Belt-crete Conveyors With Power Pack Or Similar	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Bending Machine	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Bit Grinders	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Blade (finish & Bluetop), Automatic, Cmi, Abc, Finish Athey & Huber & Similar When Used As Automatic	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Blade Operator (motor Patrol & Attachments)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Blower Operator (cement)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Boat Operator	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Bob Cat (skid Steer)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Bolt Threading Machine	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Boom Cats (side)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Boring Machine (earth)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Boring Machine (rock Under 8" Bit) (quarry Master, Joy Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>

Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Bump Cutter (wayne, Saginaw Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Cableway Controller (dispatcher)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Cableway Operators	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Canal Lining Machine (concrete)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Carrydeck & Boom Truck (under 25 Tons)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Cement Hog	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Chipper (without Crane) Cleaning & Doping Machine (pipeline)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Clamshell, Dragline	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Compactor (self-propelled With Blade)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Compressor (2000 Cfm Or Over, 2 Or More, Gas Diesel Or Electric Power)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Compressors (under 2000 Cfm, Gas, Diesel Or Electric Power)	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Concrete Cleaning / Decontamination Machine Operator	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Concrete Pump Boon Truck	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Concrete Pumps (squeeze-crete, Flow-crete, Whitman & Similar)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Concrete Saw (multiple Cut)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Concrete Slip Form Paver	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Conveyor Aggregate Delivery Systems (c.a.d.)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Crane Oiler- Driver (cdl Required) & Cable Tender, Mucking Machine	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Cranes (25 Tons & Under), All Attachments Incl. Clamshell, Dragline	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Cranes (25 Tons To And Including 45 Tons), All Attachments Incl. Clamshell, Dragline	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Cranes (45 Tons To 85 Tons), All Attachments Incl. Clamshell And Dragline	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>

Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Cranes (85 Tons & Over) And All Climbing, Overhead, Rail & Tower. All Attachments Incl.	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Crusher Feeder	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Crusher, Grizzle & Screening Plant Operator	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Curb Extruder (asphalt Or Concrete)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Deck Engineer	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Deck Hand	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Derricks & Stifflegs (65 Tons & Over)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Derricks & Stifflegs (under 65 Tons)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Distributor Leverman	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Ditch Witch Or Similar	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Dope Pots (power Agitated	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Dozer / Tractor (up To D-6 Or Equivalent) And Traxcavator	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Dozer / Tractors (d-6 & Equivalent & Over)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Dozer, 834 R/t & Similar	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Drill Doctor	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Driller Licensed	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Drillers Helper	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Drilling Equipment (8" Bit & Over) (robbins, Reverse Circulation & Similar)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Drills (churn, Core, Calyx Or Diamond)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Elevating Belt (holland Type)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Elevating Belt-type Loader (euclid, Barber Green & Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Elevating Grader-type Loader (dumor, Adams Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Elevator Hoisting Materials	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators-</u>	Equipment Serviceman,	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>

	Underground Sewer & Water	Greaser & Oiler				
Grant	Power Equipment Operators- Underground Sewer & Water	Fireman & Heater Tender	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Fork Lift Or Lumber Stacker, Hydra-life & Similar	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Generator Plant Engineers (diesel Or Electric)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Gin Trucks (pipeline)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Grade Checker	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Gunite Combination Mixer & Compressor	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	H.d. Mechanic	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	H.d. Welder	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Helicopter Pilot	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Helper, Mechanic Or Welder, H.D	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Hoe Ram	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Hoist (2 Or More Drums Or Tower Hoist)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Hoist, Single Drum	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Hydraulic Platform Trailers (goldhofer, Shaurerly And Similar)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Hydro-seeder, Mulcher, Nozzleman	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Lime Batch Tank Operator (recycle Train)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Lime Brain Operator (recycle Train)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Loader (360 Degrees Revolving Koehring Scooper Or Similar)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Loader Operator (front-end & Overhead, 4 Yds. Incl. 8 Yds.)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Loaders (bucket Elevators And Conveyors)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Loaders (overhead & Front- end, Over 8 Yds. To 10 Yds.)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Loaders (overhead & Front- end, Under 4 Yds.. R/t)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Loaders (overhead And Front- end, 10 Yds. & Over)	\$38.71	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	Power Equipment Operators- Underground Sewer & Water	Locomotive Engineer	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>

Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Longitudinal Float	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Master Environmental Maintenance Technician	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Mixer (portable - Concrete)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Mixermobile	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Mobile Crusher Operator (recycle Train)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Mucking Machine	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Multiple Dozer Units With Single Blade	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Pavement Breaker, Hydra- hammer & Similar	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Paving (dual Drum)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Paving Machine (asphalt And Concrete)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Piledriving Engineers	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Plant Oiler	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Posthole Auger Or Punch	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Power Broom	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Pump (grout Or Jet)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Pumpman	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Quad-track Or Similar Equipment	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Railroad Ballast Regulation Operator (self-propelled)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Railroad Power Tamper Operator (self-propelled)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Railroad Tamper Jack Operator (self-propelled)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Railroad Track Liner Operator (self-propelled)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Refrigeration Plant Engineer (1000 Tons & Over)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Refrigeration Plant Engineer (under 1000 Ton)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Rollerman (finishing Asphalt Pavement)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Rollers, All Types On Subgrade, Including Seal And Chip	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>

		Coating (farm Type, Case, John Deere And Similar, or Compacting Vibrator), Except When Pulled B				
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Roto Mill (pavement Grinder)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Rotomill Groundsman	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Rubber-tired Scrapers (multiple Engine With Three Or More Scrapers)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Rubber-tired Skidders (r/t With Or Without Attachments)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Scrapers, All, Rubber-tired	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Screed Operator	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Shovels (3 Yds. & Over)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Shovels (under 3 Yds.)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Signalman (whirleys, Highline, Hammerheads Or Similar)	\$37.06	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Soil Stabilizer (p & H Or Similar)	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Spray Curing Machine (concrete)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Spreader Box (self-propelled)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Spreader Machine	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Steam Cleaner	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Straddle Buggy (ross & Similar On Construction Job Only)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Surface Heater & Planer Machine	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Tractor (farm Type R/t With Attachments, Except Backhoe)	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Traverse Finish Machine	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Trenching Machines (7 Ft. Depth & Over)	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Trenching Machines (under 7 Ft. Depth Capacity)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Tug Boat Operator	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Tugger Operator	\$36.13	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Turnhead (with Re-screening)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>

	<u>Underground Sewer & Water</u>					
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Turnhead Operator	\$36.74	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Ultra High Pressure Waterjet Cutting Tool System Operator, (30,000 Psi)	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Vactor Guzzler, Super Sucker	\$37.34	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Vacuum Blasting Machine Operator	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Vacuum Drill (reverse Circulation Drill Under 8" Bit)	\$36.90	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Welding Machine	\$35.81	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Equipment Operators- Underground Sewer & Water</u>	Whirleys & Hammerheads, All	\$37.61	<u>7B</u>	<u>1M</u>	<u>8D</u>
Grant	<u>Power Line Clearance Tree Trimmers</u>	Journey Level In Charge	\$41.04	<u>5A</u>	<u>4A</u>	
Grant	<u>Power Line Clearance Tree Trimmers</u>	Spray Person	\$38.98	<u>5A</u>	<u>4A</u>	
Grant	<u>Power Line Clearance Tree Trimmers</u>	Tree Equipment Operator	\$41.04	<u>5A</u>	<u>4A</u>	
Grant	<u>Power Line Clearance Tree Trimmers</u>	Tree Trimmer	\$36.75	<u>5A</u>	<u>4A</u>	
Grant	<u>Power Line Clearance Tree Trimmers</u>	Tree Trimmer Groundperson	\$27.80	<u>5A</u>	<u>4A</u>	
Grant	<u>Refrigeration & Air Conditioning Mechanics</u>	Journey Level	\$27.67		<u>1</u>	
Grant	<u>Residential Brick Mason</u>	Journey Level	\$40.03	<u>5A</u>	<u>1M</u>	
Grant	<u>Residential Carpenters</u>	Journey Level	\$13.86		<u>1</u>	
Grant	<u>Residential Cement Masons</u>	Journey Level	\$9.50		<u>1</u>	
Grant	<u>Residential Drywall Applicators</u>	Journey Level	\$17.49		<u>1</u>	
Grant	<u>Residential Drywall Tapers</u>	Journey Level	\$14.00		<u>1</u>	
Grant	<u>Residential Electricians</u>	Journey Level	\$22.95		<u>1</u>	
Grant	<u>Residential Glaziers</u>	Journey Level	\$13.80		<u>1</u>	
Grant	<u>Residential Insulation Applicators</u>	Journey Level	\$10.00		<u>1</u>	
Grant	<u>Residential Laborers</u>	Journey Level	\$11.10		<u>1</u>	
Grant	<u>Residential Marble Setters</u>	Journey Level	\$40.03	<u>5A</u>	<u>1M</u>	
Grant	<u>Residential Painters</u>	Journey Level	\$13.52		<u>1</u>	
Grant	<u>Residential Plumbers & Pipefitters</u>	Journey Level	\$21.17		<u>1</u>	
Grant	<u>Residential Refrigeration & Air Conditioning Mechanics</u>	Journey Level	\$21.17		<u>1</u>	
Grant	<u>Residential Sheet Metal Workers</u>	Journey Level	\$26.53		<u>1</u>	
Grant	<u>Residential Soft Floor Layers</u>	Journey Level	\$22.77		<u>1</u>	
Grant	<u>Residential Sprinkler Fitters</u>	Journey Level	\$16.84		<u>1</u>	

	(Fire Protection)				
Grant	<u>Residential Stone Masons</u>	Journey Level	\$40.03	<u>5A</u>	<u>1M</u>
Grant	<u>Residential Terrazzo Workers</u>	Journey Level	\$8.67		<u>1</u>
Grant	<u>Residential Terrazzo/Tile Finishers</u>	Journey Level	\$17.00		<u>1</u>
Grant	<u>Residential Tile Setters</u>	Journey Level	\$8.67		<u>1</u>
Grant	<u>Roofers</u>	Journey Level	\$26.11		<u>1</u>
Grant	<u>Sheet Metal Workers</u>	Journey Level	\$44.51	<u>6Z</u>	<u>1B</u>
Grant	<u>Shipbuilding & Ship Repair</u>	Journey Level	\$8.67		<u>1</u>
Grant	<u>Sign Makers & Installers (Electrical)</u>	Journey Level	\$52.65	<u>7F</u>	<u>1E</u>
Grant	<u>Sign Makers & Installers (Non-Electrical)</u>	Journey Level	\$14.65		<u>1</u>
Grant	<u>Soft Floor Layers</u>	Journey Level	\$22.77		<u>1</u>
Grant	<u>Solar Controls For Windows</u>	Journey Level	\$8.67		<u>1</u>
Grant	<u>Sprinkler Fitters (Fire Protection)</u>	Journey Level	\$47.35	<u>7J</u>	<u>1R</u>
Grant	<u>Stage Rigging Mechanics (Non Structural)</u>	Journey Level	\$13.23		<u>1</u>
Grant	<u>Stone Masons</u>	Journey Level	\$40.03	<u>5A</u>	<u>1M</u>
Grant	<u>Street And Parking Lot Sweeper Workers</u>	Journey Level	\$14.00		<u>1</u>
Grant	<u>Surveyors</u>	All Classifications	\$28.57	<u>Null</u>	<u>1</u>
Grant	<u>Telecommunication Technicians</u>	Journey Level	\$17.65		<u>1</u>
Grant	<u>Telephone Line Construction - Outside</u>	Cable Splicer	\$32.27	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Hole Digger/Ground Person	\$18.10	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Installer (Repairer)	\$30.94	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Special Aparatus Installer I	\$32.27	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Special Apparatus Installer II	\$31.62	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Telephone Equipment Operator (Heavy)	\$32.27	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Telephone Equipment Operator (Light)	\$30.02	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Telephone Lineperson	\$30.02	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Television Groundperson	\$17.18	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Television Lineperson/Installer	\$22.73	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Television System Technician	\$27.09	<u>5A</u>	<u>2B</u>
Grant	<u>Telephone Line Construction - Outside</u>	Television Technician	\$24.35	<u>5A</u>	<u>2B</u>

	<u>Outside</u>				
Grant	<u>Telephone Line Construction - Outside</u>	Tree Trimmer	\$30.02	<u>5A</u>	<u>2B</u>
Grant	<u>Terrazzo Workers</u>	Journey Level	\$31.90	<u>5A</u>	<u>1M</u>
Grant	<u>Tile Setters</u>	Journey Level	\$31.90	<u>5A</u>	<u>1M</u>
Grant	<u>Tile, Marble & Terrazzo Finishers</u>	Journey Level	\$27.82	<u>5A</u>	<u>1M</u>
Grant	<u>Traffic Control Stripers</u>	Journey Level	\$39.40	<u>7A</u>	<u>1K</u>
Grant	<u>Truck Drivers</u>	Dump Truck	\$26.09		<u>1</u>
Grant	<u>Truck Drivers</u>	Dump Truck And Trailer	\$26.09		<u>1</u>
Grant	<u>Truck Drivers</u>	Other Trucks	\$27.84		<u>1</u>
Grant	<u>Truck Drivers</u>	Transit Mixer	\$10.00		<u>1</u>
Grant	<u>Well Drillers & Irrigation Pump Installers</u>	Irrigation Pump Installer	\$13.61		<u>1</u>
Grant	<u>Well Drillers & Irrigation Pump Installers</u>	Oiler	\$9.20		<u>1</u>
Grant	<u>Well Drillers & Irrigation Pump Installers</u>	Well Driller	\$18.00		<u>1</u>

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Work covered by the Contract Documents.
- 2. Type of the Contract.
- 3. Work sequencing.
- 4. Use of premises.
- 5. Owner's occupancy requirements.
- 6. Work restrictions.
- 7. Specification formats and conventions.

- B. Related Sections include the following:

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

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Grant County Landfill Complex

- 1. Project Location: Ephrata, WA

- B. Owner: Grant County Public Works, 124 Enterprise Street SE, Ephrata, WA 98823

- C. Architect: Zeck Butler Architects PS, 421 W Riverside Suite 860, Spokane, WA 99201

- D. The Work consists of the following:

- 1. The project includes both demolition and construction activities at the existing landfill site. The Owner's activities will continue during work under this contract and access onto site and vehicular circulation on site must be maintained. Work is expected to follow the sequencing identified in the documents, although slight modifications may be considered to accommodate a more desirable schedule.
- 2. In general, work shall include the construction of a new access and support facilities for the landfill. New structures include a 8,500 square foot Shop Building, 48-foot by 12-foot Recycling Shed, Vehicle Refueling Station, and Scale House. Site work includes

DIVISION 1- GENERAL REQUIREMENTS

construction of new roadways, vehicle scales, asphalt parking areas, gravel surfacing, landscaping, fencing, signage and utilities.

1.4 TYPE OF CONTRACT

- A. Project will be constructed under a single prime contract.

1.5 WORK SEQUENCE

- A. The Work shall be conducted in a progression that allows the County to continue operation of the Landfill during construction. The following sequence of work is expected:
 - 1. Construction of new complex on east side of Landfill. No disruption of the Owner's or the public's access to the Landfill is allowed and any disruption of power, water, or other utilities must be scheduled at least 2 days in advance.
 - 2. Upon completion of item #1, above, and after punchlist items have been completed, including issuance of a Certificate of Occupancy, work shall be scheduled to move the existing scale to its new location. This work shall occur over a weekend and be completed by Monday morning, allowing the Landfill to fully operate from the new entrance location with both new and existing scales.
- B. Before commencing Work submit a schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all portions of the Work.

1.6 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.
- B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public.
 - 2. Driveways and Entrances: Keep existing driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 OWNER'S OCCUPANCY REQUIREMENTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.

DIVISION 1- GENERAL REQUIREMENTS

1. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.8 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's written permission.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.
1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

DIVISION 1- GENERAL REQUIREMENTS

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
- C. Organization of Specifications: The specifications are prepared in sections which conform generally with trade practices. These sections are for Owner and Contractor convenience and shall not control Contractor in dividing the work among the Subcontractors or in establishing the extent of the work to be performed by any trade.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

DIVISION 1 - GENERAL REQUIREMENTS

- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
1. Include installation costs in purchase amount only where indicated as part of the allowance.
 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than 21 days after such authorization.
1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

DIVISION 1 - GENERAL REQUIREMENTS

- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Change Orders (numbers) that affect value.
 - d. Dollar value.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training in the amount of 5 percent of the Contract Sum.
 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing.
 6. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
 7. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.

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2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Submittals Schedule (preliminary if not final).
 5. List of Contractor's staff assignments.
 6. Copies of building permits.
 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 8. Report of preconstruction conference.
 9. Certificates of insurance and insurance policies.
 10. Performance and payment bonds.
 11. Statements of Intend to Pay Prevailing Wages.
- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
 2. Administrative actions and submittals that shall precede or coincide with this application include:
 - a. Occupancy permit and similar approvals.
 - b. Warranties (guarantees) and maintenance agreements.
 - c. Test/Adjust/Balance records.
 - d. Maintenance instructions.
 - e. Start-up performance reports.
 - f. Final cleaning.
 - g. List of incomplete work recognized as exceptions to Architect's Certificate of Substantial completion.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. Evidence that claims have been settled.

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5. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
6. Final, liquidated damages settlement statement.
7. Affidavits of Wages Paid and Request for Release, as issued by WA State Department of Labor and Industries.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
 - 4. Requests for Interpretation (RFIs).
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 2. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

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

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4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
 2. Preparation of the Schedule of Values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
 9. Project closeout activities.
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate required installation sequences.
 - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 2. Sheet Size: At least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 22 by 34 inches (560 by 864 mm).

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3. Number of Copies: Submit two opaque copies of each submittal. Architect will return one copy.
 4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
1. Include special personnel required for coordination of operations with other contractors.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

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2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises.
 - m. Work restrictions.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Construction waste management and recycling.
 - q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.
 - u. Security.
 - v. Progress cleaning.
 - w. Working hours.
 3. Minutes: Architect will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- D. Progress Meetings: Conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

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- 1) Review schedule for next period.
- b. Review present and future needs of each entity present.
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.

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4. Name of Architect.
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs: CSI Form 13.2A or similar form.
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

DIVISION 1 - GENERAL REQUIREMENTS

- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Field condition reports.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
 - 3. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 4. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.

DIVISION 1 - GENERAL REQUIREMENTS

- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- H. Major Area: A story of construction, a separate building, or a similar significant construction element.
- I. Milestone: A key or critical point in time for reference or measurement.
- J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

- A. Preliminary Construction Schedule: Submit two opaque copies.
 - 1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.
- B. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
- C. Field Condition Reports: Submit [two] <Insert number> copies at time of discovery of differing conditions.

DIVISION 1 - GENERAL REQUIREMENTS

1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 4. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.

DIVISION 1 - GENERAL REQUIREMENTS

- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.2 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 REPORTS

- A. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 - 1. Subparagraphs below include submittals usually specified in other Sections. Revise to suit Project.
 - 2. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
 - 3. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 - 4. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 5. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 6. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 7. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.4 GENERAL SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

DIVISION 1 - GENERAL REQUIREMENTS

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- E. **Submittals shall be transmitted and reviewed through an Electronic Submittal Process, as described in paragraph 1.5, Electronic Submittal Procedures.**
1. Color Charts, Samples or other similar submittals shall be made through conventional methods. Deliver these submittals to the Architect's office for review.
 - a. One (1) copy/sample of each delivered submittal will be maintained by the Architect. If a copy/sample is required to be returned, provide quantity to accommodate.

1.5 ELECTRONIC SUBMITTAL PROCEDURES

- A. Summary:
1. Shop drawing and product data submittals shall be transmitted to Architect in electronic (PDF) format using Submittal Exchange, a website service designed specifically for transmitting submittals between construction team members.
 2. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
 3. The electronic submittal process is not intended for color samples, color charts, or physical material samples.

DIVISION 1 - GENERAL REQUIREMENTS

B. Procedures:

1. Submittal Preparation - Contractor may use any or all of the following options:
 - a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the Submittal Exchange website.
 - b. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format.
 - c. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
2. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
3. Contractor shall transmit each submittal to Architect using the Submittal Exchange website, www.submittalexchange.com.
4. Architect / Engineer review comments will be made available on the Submittal Exchange website for downloading. Contractor will receive email notice of completed review.
5. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
6. Submit paper copies of reviewed submittals at project closeout for record purposes in accordance with Section 017823 – Operation and Maintenance Data.

C. Costs:

1. General Contractor shall include the full cost of Submittal Exchange project subscription in their proposal. This cost is to be included in the Contract Amount. Contact Submittal Exchange at 1-800-714-0024 to verify cost prior to bid.
2. At Contractor's option, training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 1-800-714-0024.
3. Internet Service and Equipment Requirements:
 - a. Email address and Internet access at Contractor's main office.
 - b. Adobe Acrobat (www.adobe.com), Bluebeam PDF Revu (www.bluebeam.com), or other similar PDF review software for applying electronic stamps and comments.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Submit electronic submittals directly to extranet specifically established for Project.

DIVISION 1 - GENERAL REQUIREMENTS

- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 4. Submit Product Data before or concurrent with Samples.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Schedules.
 - g. Design calculations.
 - h. Compliance with specified standards.
 - i. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
 - k. Relationship to adjoining construction clearly indicated.
 - l. Seal and signature of professional engineer if specified.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
- E. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- F. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- G. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

DIVISION 1 - GENERAL REQUIREMENTS

- H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
 2. General description of work performed by each subcontractor.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
- B. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- E. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- F. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
 2. Required substrate tolerances.
 3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.

2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

DIVISION 1 - GENERAL REQUIREMENTS

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 2. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
 - 3. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

DIVISION 1 - GENERAL REQUIREMENTS

- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, 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 requirements specified apply exclusively to tradespeople of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits.

DIVISION 1 - GENERAL REQUIREMENTS

To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- C. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

DIVISION 1 - GENERAL REQUIREMENTS

- B. **Installer Qualifications:** A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. **Specialists:** Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. **Testing Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.

DIVISION 1 - GENERAL REQUIREMENTS

- d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

DIVISION 1 - GENERAL REQUIREMENTS

- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 of date established for commencement of the Work.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.

DIVISION 1 - GENERAL REQUIREMENTS

- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 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. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

DIVISION 1 - GENERAL REQUIREMENTS

bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
- D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253
CRD	Handbook for Concrete and Cement Available from Army Corps of Engineers Waterways Experiment Station www.wes.army.mil	(601) 634-2355
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
NES	(Formerly: National Evaluation Service) (See ICC-ES)	
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

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AA	Aluminum Association, Inc. (The) www.aluminum.org	(202) 862-5100
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America www.alca.org	(800) 395-2522 (703) 736-9666
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300

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ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (212) 591-7722
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association www.awpa.com	(334) 874-9800
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
FM	Factory Mutual System (Now FMG)	
GA	Gypsum Association www.gypsum.org	(202) 289-5440
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234

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IGMA	Insulating Glass Manufacturers Alliance (The) www.igmaonline.org	(613) 233-1510
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
UL	Underwriters Laboratories Inc. www.ul.com	(800) 285-4476 (847) 272-8800
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422

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WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WIC	Woodwork Institute of California (Now WI)	
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council (Formerly: CABO - Council of American Building Officials) www.iccsafe.org	(703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
NES	National Evaluation Service (See ICC-ES)	

- D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999

DIVISION 1 - GENERAL REQUIREMENTS

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
 - 2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 3. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to Architect, testing agencies, and authorities having jurisdiction.
- B. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

DIVISION 1 - GENERAL REQUIREMENTS

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack board.
 3. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Use of water truck or holding tank required until water service installed from existing Landfill well location.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- D. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities.
 - 1. Provide additional telephone lines for the following:

DIVISION 1 - GENERAL REQUIREMENTS

- a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
 - b. Provide one telephone line for Owner's use.
2. Post a list of important telephone numbers.
- a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
- I. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary parking areas for construction personnel.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- E. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that

DIVISION 1 - GENERAL REQUIREMENTS

minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
 - 1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- E. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- F. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- G. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may

DIVISION 1 - GENERAL REQUIREMENTS

have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 01 Section "References" for applicable industry standards for products specified.
 - 2. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
 - 3. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

DIVISION 1 - GENERAL REQUIREMENTS

- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use facsimile of form provided at end of Section.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

DIVISION 1 - GENERAL REQUIREMENTS

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Store cementitious products and materials on elevated platforms.
 5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 7. Protect stored products from damage and liquids from freezing.
 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 - 3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.

DIVISION 1 - GENERAL REQUIREMENTS

5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

DIVISION 1 - GENERAL REQUIREMENTS

- a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
- a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.

DIVISION 1 - GENERAL REQUIREMENTS

10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

This substitution request form may be used for Pre-Bid Substitution Requests or Post-Bid Substitution Requests as specified in Divisions 1 Section -"Substitutions".

TO: _____

PROJECT: _____

SPECIFICATION ITEM: _____

Section	Page	Paragraph	Description
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Substitution approval is an acceptance of only the manufacturer and product for general conformance with the design concept reflected in the Contract Documents. The A/E has made no attempt to verify specific performance data, or to check the 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 person/entity submitting the proposed substitution.

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs, performance and test data, adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on the Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be **locally** available for the proposed substitution.

The undersigned further certifies that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

The undersigned agrees that, if this page is reproduced, the terms and conditions for substitutions found in the Bidding Documents apply to this request.

SUBMITTED BY:

Name (Printed)

General Contractor (if after award of Contract)

Signature

For use by the A/E

Approved Approved as noted

Firm Name

Not Approved Received too late

Address

City, State, Zip

By

Date

Date

Telephone

Fax

Remarks

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Divisions 2 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

DIVISION 1 - GENERAL REQUIREMENTS

7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

DIVISION 1 - GENERAL REQUIREMENTS

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for environmental-protection measures during construction, and location of waste containers at Project site.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 50 percent by weight of total waste generated by the Work.
- B. Salvage/Recycle Goals: Owner's goal is to salvage and recycle as much nonhazardous demolition construction waste as possible.

1.5 SUBMITTALS

- A. Waste Management Plan: Submit 3 copies of plan within 7 days of date established for commencement of the Work.
- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit three copies of report. Include the following information:

DIVISION 1 – GENERAL REQUIREMENTS

1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste in tons (tonnes).
 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
 2. Review requirements for documenting quantities of each type of waste and its disposition.
 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

DIVISION 1 – GENERAL REQUIREMENTS

- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement waste management plan as approved by Architect. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

DIVISION 1 – GENERAL REQUIREMENTS

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner accrue to Contractor.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in Division 32 Section "Plants" for use of clean sawdust as organic mulch.
- C. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

DIVISION 1 – GENERAL REQUIREMENTS

- a. Comply with requirements in Division 32 Section "Plants" for use of clean ground gypsum board as inorganic soil amendment.

3.4 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Transport waste materials and dispose of at designated spoil areas on Owner's property.
- E. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

- 1. Inspection procedures.
- 2. Warranties.
- 3. Final cleaning.

- B. Related Sections include the following:

- 1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- 2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- 3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- 4. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

- 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
- 2. Advise Owner of pending insurance changeover requirements.
- 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
- 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
- 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
- 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

DIVISION 1 - GENERAL REQUIREMENTS

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report and warranty.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

DIVISION 1 - GENERAL REQUIREMENTS

1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

DIVISION 1 - GENERAL REQUIREMENTS

- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - j. Remove labels that are not permanent.
 - k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Replace parts subject to unusual operating conditions.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - r. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

- 1. Operation and maintenance documentation directory.
- 2. Emergency manuals.
- 3. Operation manuals for systems, subsystems, and equipment.

- B. Related Sections include the following:

- 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
- 2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
- 3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
- 4. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

- A. Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
 - 1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name, address, and telephone number of Contractor.

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6. Name and address of Architect.
 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.

DIVISION 1 - GENERAL REQUIREMENTS

2. Performance and design criteria if Contractor is delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

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- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard printed maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.

DIVISION 1 - GENERAL REQUIREMENTS

3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

DIVISION 1 - GENERAL REQUIREMENTS

- E. **Manufacturers' Data:** Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

- F. **Drawings:** Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."

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

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Sections include the following:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up Record Prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal: Submit one set of marked-up Record Prints. Architect will return prints for organizing into sets, printing, binding, and final submittal.
 - b. Final Submittal: Submit one set of marked-up Record Prints.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.
 - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

DIVISION 1 - GENERAL REQUIREMENTS

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

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

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

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. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Building walls.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
 - 2. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. 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.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

- E. Qualification Data: For Installer, manufacturer, and testing agency.
- F. 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. Curing compounds.
 - 6. Vapor retarders.
 - 7. Joint-filler strips.
 - 8. Repair materials, if needed.
- G. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- H. Field quality-control test and inspection reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Owner-Retained Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be 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. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33 coarse aggregate or better, graded. Provide aggregates from a single source.
 1. Maximum Coarse-Aggregate Size: As indicated on the Contract Drawings.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Available Products:
 - a. Fortifiber Corporation; Moistop Ultra.
 - b. Raven Industries Inc.; Vapor Block 10.
 - c. Stego Industries, LLC; Stego Wrap, 15 mils.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Water-Soluble, Alkali-Silicate, Curing and Sealing Compound.
1. Basis-of-Design Product: Subject to compliance with requirements, provide "Kure-N-Harden" by BASF Building Systems or comparable product/
 - a. VOC Content: None.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.10 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 C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: 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 C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 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 according to ASTM C 109/C 109M.

2.11 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, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as indicated on the Contract Drawings.
- B. Foundation Walls: Proportion normal-weight concrete mixture as indicated on the Contract Drawings.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as indicated on the Contract Drawings.
- D. Building Walls: Proportion normal-weight concrete mixture as indicated on the Contract Drawings.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch (6 mm)] for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.

- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 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. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. 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. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.
- C. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fifth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/4-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
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 will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. 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. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. 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.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. 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. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to floor and slab surfaces exposed to view or to be covered with resilient flooring.

2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

a. 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; for slabs-on-grade.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. 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: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Floor Slabs: Cure and seal all concrete floor slab surfaces with Curing and Sealing compound specified. Follow manufacturer's written instructions for application.
 - 1. DO NOT allow curing compound residue to dry on the surface.
- E. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- F. Provide Water Repellant, specified in Section 071900, on all exposed, unfinished concrete walls, including foundation walls and concrete wainscot walls.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. 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 joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half 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 in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. 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 will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include 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.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections: As indicated on the Contract Drawings.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, 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.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

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5. Unit Weight: ASTM C 567, 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.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 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.
 9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 11. Additional 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.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 033000

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. This Section includes the following:
 - 1. Composite floor deck.
 - 2. Noncomposite form deck.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
 - 2. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 3. Division 09 painting Sections for repair painting of primed deck.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Field quality-control test and inspection reports.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- B. 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."

1.5 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 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. Steel Deck:

- a. ASC Profiles, Inc.
- b. Canam Steel Corp.;The Canam Manac Group.
- c. Consolidated Systems, Inc.
- d. DACS, Inc.
- e. D-Mac Industries Inc.
- f. Epic Metals Corporation.
- g. Marlyn Steel Decks, Inc.
- h. New Millennium Building Systems, LLC.
- i. Nucor Corp.; Vulcraft Division.
- j. United Steel Deck, Inc.
- k. Valley Joist; Division of EBSCO Industries, Inc.
- l. Verco Manufacturing Co.
- m. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 COMPOSITE FLOOR DECK

- A. Composite Steel 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. 30, with the minimum section properties indicated, and with the following:
 - 1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray baked-on, rust-inhibitive primer.
 - 2. Profile Depth: 1-1/2 inches (38 mm).
 - 3. Design Uncoated-Steel Thickness: 0.0474 inch (18-gauge).
 - 4. Span Condition: Triple span or more.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- C. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, [**0.0598 inch (1.52 mm)**] [**0.0747 inch (1.90 mm)**] thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.
- D. 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.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, 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.
- 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. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.3 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 3/4 inch (19 mm), nominal.

2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (910 mm), and as follows:
1. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- 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.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior load-bearing wall framing.
 - 2. Exterior non-load-bearing wall framing.
- B. Related Sections include the following:
 - 1. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Miscellaneous structural clips and accessories.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements,

including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- D. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
 1. Allied Studco.
 2. AllSteel Products, Inc.
 3. California Expanded Metal Products Company.
 4. Clark Steel Framing.
 5. Consolidated Fabricators Corp.; Building Products Division.
 6. Craco Metals Manufacturing, LLC.
 7. Custom Stud, Inc.
 8. Dale/Incor.
 9. Design Shapes in Steel.
 10. Dietrich Metal Framing; a Worthington Industries Company.
 11. Formetal Co. Inc. (The).
 12. Innovative Steel Systems.
 13. MarinoWare; a division of Ware Industries.
 14. Quail Run Building Materials, Inc.
 15. SCAFCO Corporation.
 16. Southeastern Stud & Components, Inc.
 17. Steel Construction Systems.
 18. Steeler, Inc.
 19. Super Stud Building Products, Inc.
 20. United Metal Products, Inc.

2.2 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as indicated on the Contract Drawings:

2.3 COLD FORMED WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges as indicated on the Contract Drawings.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges as indicated on the Contract Drawings.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges as indicated in the Contract Drawings.
- D. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 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. Dietrich Metal Framing; a Worthington Industries Company.
 - b. MarinoWare, a division of Ware Industries.
 - c. SCAFCO Corporation
 - d. The Steel Network, Inc.
- E. 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 and lateral loads and transfer them to the primary structure.

2.4 COLD FORMED JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched, with stiffened flanges as indicated on the Contract Drawings.
- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges as indicated on the Contract Drawings.

2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight 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, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: As indicated on the Contract Drawings.
- C. Expansion Anchors: As indicated on the Contract Drawings.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials as indicated on the Contract Drawings.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws as indicated on the Contract Drawings.
 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035 or ASTM A 780.
- B. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

2.8 FABRICATION

- A. Fabricate cold-formed metal 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 metal framing members by welding, screw fastening, clinch 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 Contract Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Contract Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance 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 metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete construction.
- D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to 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 metal 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 metal 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 and install according to Contract Drawings, and complying 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 comparable in intensity 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. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- I. Erection Tolerances: Install cold-formed metal 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.

3.4 LOAD-BEARING WALL INSTALLATION

- 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 indicated in the Contract Drawings.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Stud Spacing: As indicated in the Contract 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. 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 as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. 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 as indicated on Contract Drawings. Fasten jamb members together to uniformly distribute loads.
 - 2. Install runner 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 horizontal bridging in stud system, spaced as indicated in the Contract Drawings. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- I. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

- 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 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as indicated on the Contract 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.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Contract Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking as indicated on the Contract Drawings.
 - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.6 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on the Contract Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.

2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Contract Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as indicated on the Contract Drawings.
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on the Contract Drawings.
 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated as indicated on the Contract Drawings. Fasten bridging at each joist intersection as follows:
 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 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. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

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. Rough hardware.
2. Loose bearing and leveling plates
3. Miscellaneous framing and supports for the following
 - a. Overhead doors.
 - b. Applications where framing and supports are not specified in other sections
4. Miscellaneous steel trim, including the following
 - a. Steel angle corner guards.
 - b. Edgings.
5. Pipe bollards.
6. Sheet metal

- B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
2. Division 05 Section "Structural Steel Framing."

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 2. Provide templates for anchors and bolts specified for installation under other Sections.
 - 3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- D. Welding certificates.
- E. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- D. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts.
- D. Anchor Bolts: ASTM F 1554, Grade 36.
 - 1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

- G. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- H. Wood Screws: Flat head, ASME B18.6.1.
- I. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- J. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- K. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material for Anchors in Exterior Locations: Stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
 - 1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
 - 1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

- I. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts if units are installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches (200 mm), unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim and interior miscellaneous steel trim, where indicated.
- D. Prime exterior miscellaneous steel trim and interior miscellaneous steel trim, where indicated with zinc-rich primer.

2.9 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
 - E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 - F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING PIPE BOLLARDS

- A. Fill bollards solidly with concrete, mounding top surface.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Industrial stairs with steel grating treads.
2. Handrails and railings attached to metal stairs.
3. Handrails attached to walls adjacent to metal stairs.

- B. Related Sections include the following:

1. Division 5 Section "Pipe and Tube Railings" for pipe and tube handrails and railings not attached to metal stairs or to walls adjacent to metal stairs.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal stairs capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each component of metal stairs.

1. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 lbf/sq. ft. (4.79 kN/sq. m) or a concentrated load of 300 lbf (1.33 kN) on an area of 4 sq. in. (25.8 sq. cm), whichever produces the greater stress.
2. Stair Framing: Capable of withstanding stresses resulting from loads specified above in addition to stresses resulting from railing system loads.
3. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

- B. Structural Performance of Handrails and Railings: Provide handrails and railings complying with requirements in ASTM E 985 for structural performance, based on testing performed according to ASTM E 894 and ASTM E 935.

- C. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding the allowable design working stress of materials for handrails, railings, anchors, and connections:

1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
 - b. Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.

2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
 - b. Uniform load of 50 lbf/ft. (730 N/m) applied in any direction.

3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
 - a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guards.

1.4 SUBMITTALS

- A. Product Data: For metal stairs and the following:
 1. Steel floor gratings.
 2. Paint products.

- B. Shop Drawings: Show fabrication and installation details for metal stairs. Include plans, elevations, sections, and details of metal stairs and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- C. Samples for Initial Selection: Manufacturer's color charts or sections of units showing the full range of colors and patterns for the following products:
 1. Grating treads.

- D. Welding Certificates: Copies of certificates for welding procedures and personnel.

- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Arrange for metal stairs specified in this Section to be fabricated and installed by the same firm.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal stairs (including handrails and railing systems) that are similar to those indicated for this Project in material, design, and extent.
- C. Fabricator Qualifications: A firm experienced in producing metal stairs similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 COORDINATION

- A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 FERROUS METALS

- A. Metal Surfaces, General: Provide metal free from pitting, seam marks, roller marks, and other imperfections where exposed to view on finished units. Do not use steel sheet with variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- D. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- F. Steel Bars for Gratings: ASTM A 36/A 36M.
- G. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).

- H. Uncoated, Cold-Rolled Steel Sheet: Commercial quality, complying with ASTM A 366/A 366M; or structural quality, complying with ASTM A 611, Grade A, unless another grade is required by design loads.
- I. Uncoated, Hot-Rolled Steel Sheet: Commercial quality, complying with ASTM A 569/A 569M; or structural quality, complying with ASTM A 570/A 570M, Grade 30, unless another grade is required by design loads.
- J. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial quality or structural quality, Grade 33 (Grade 230), unless another grade is required for design loads.
- K. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.2 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- D. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- E. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).
- F. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).

2.3 PAINT

- A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."
- B. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 GROUT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, handrails, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding, unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
 - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - 1. Architectural class, where indicated.
 - 2. Commercial class, unless otherwise indicated.
 - 3. Service class, unless otherwise indicated.
 - 4. Industrial class, where indicated.

- C. Shop Assembly: Preassemble stairs in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- D. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Shear and punch metals cleanly and accurately. Remove sharp or rough areas on exposed surfaces.

- E. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously, unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

- H. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

- A. Stair Framing: Fabricate stringers of structural-steel channels, plates, or a combination of both, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural-steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; bolt or weld framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
- B. Floor Grating Treads and Platforms: Form to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual for Steel Stainless Steel, and Aluminum Gratings and Stair Treads."
 - 1. Fabricate treads and platforms from welded steel grating with 1-1/4-by-3/16-inch (32-by-5-mm) bearing bars at 15/16 inch (24 mm) o.c. and crossbars at 4 inches (100 mm) o.c., NAAMM designation: W-15-4 (1-1/4 x 3/16) STEEL.
 - 2. Surface: Serrated.
 - 3. Finish: Shop primed.
 - 4. Fabricate grating treads with steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

2.7 STAIR HANDRAILS AND RAILINGS

- A. General: Comply with applicable requirements in Division 5 Section "Pipe and Tube Railings" for handrails and railings, and as follows:
 - 1. Railings may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
 - 2. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

2.8 FINISHES

- A. Comply with NAAMM'S "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal stairs after assembly.
- C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed products:
 - 1. Interiors (SSPC Zone 1A): SSPC SP 3, "Power Tool Cleaning."

- D. Apply shop primer to prepared surfaces of metal stair components, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Do not apply primer to galvanized surfaces.
 2. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- F. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of base plates.

- B. Set steel stair base plates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, non-shrink grout, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING STEEL TUBE RAILINGS AND HANDRAILS

- A. Adjust handrails and railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.
- B. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 3. For hollow masonry anchorage, use toggle bolts.
 - 4. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting."

END OF SECTION 055100

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe handrails and railing systems.
 - 2. Wire mesh for guardrails.

1.3 DEFINITIONS

- A. Definitions in ASTM E 985 for railing-related terms apply to this Section.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on the following:
 - 1. Testing performed according to ASTM E 894 and E 935.
- B. Thermal Movements: Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in engineering, fabricating, and installing handrails and railing systems to prevent buckling, opening of joints, overstressing of components and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C) ambient 180 deg F (100 deg C) material surfaces.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Shop drawings showing fabrication and installation of handrails and railing systems including plans, elevations, sections, details of components, and attachments to other units of Work.

1.6 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain handrails and railing systems of each type and material from a single manufacturer.

1.7 STORAGE

- A. Store handrails and railing systems inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Where handrails and railing systems are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 SEQUENCING AND SCHEDULING

- A. Sequence and coordinate installation of wall handrails as follows:
 - 1. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.
 - 2. Mount handrails on gypsum board assemblies only where reinforced to receive anchors and where the location of concealed reinforcements has been clearly marked for benefit of Installer.

PART 2 - PRODUCTS

2.1 METALS

- A. General: Provide metals free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.
- B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:
 - 1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

- a. Black finish, unless otherwise indicated.
 - b. Type F, or Type S, Grade A, standard weight (schedule 40), unless otherwise indicated, or another weight, type, and grade required by structural loads.
2. Steel Plates, Shapes, and Bars: ASTM A 36 (ASTM A 36M).
- C. Brackets, Flanges, and Anchors: Cast or formed metal of the same material and finish as supported rails, unless otherwise indicated.
- D. Wire Mesh Sheets: 4 inch x 4 inch x 6 gage for guardrails where indicated.

2.2 WELDING MATERIALS, FASTENERS, AND ANCHORS

- A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railings to other types of construction indicated and capable of withstanding design loadings.
1. For steel railings and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
- C. Fasteners for Interconnecting Railing Components: Use fasteners of same basic metal as the fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
1. Provide concealed fasteners for interconnecting railing components and their attachment to other work, except where exposed fasteners are unavoidable or are the standard fastening method for handrail and railing system indicated.

2.3 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure, complying with performance requirements of FS TT-P-664.

2.4 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION

- A. General: Fabricate handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than those required to support structural loads.
- B. Assemble handrails and railing systems in the shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- C. Form changes in direction of members as follows:
 - 1. By radius bends.
- D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- E. Welded Connections: Fabricate handrails and railing systems for connection of members by welding. For connections made during fabrication, weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- F. Non-welded Connections: Fabricate handrails and railing systems by connecting members with railing manufacturer's standard concealed mechanical fasteners and fittings, unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- G. Brackets, Flanges, Fittings, and Anchors: Provide manufacturer's standard wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing system members to other construction.
- H. Provide inserts and other anchorage devices to connect handrails and railing systems to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.
- I. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

- J. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.
- K. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.
- L. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- M. Fillers: Provide steel sheet or plate fillers, of thickness and size indicated or required to support structural loads of handrails, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses to produce adequate bearing to prevent bracket rotation and overstressing substrate.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and they are assembled or installed to minimize contrast.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railing systems.

2.7 STEEL FINISHES

- A. For non-galvanized steel handrails and railing systems, provide nongalvanized ferrous metal fittings, brackets, fasteners, and sleeves, except provide galvanized anchors where embedded in exterior masonry and concrete construction.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed railings:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6 "Commercial Blast Cleaning."
- C. Apply shop primer to prepared surfaces of handrails and railing components, unless otherwise indicated. Comply with requirements of SSPC-PA 1 "Paint Application Specification No. 1" for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections accurately together to form tight, hairline joints.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing handrails and railing systems. Set handrails and railing systems accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.
 - 1. Do not weld, cut, or abrade surfaces of handrails and railing components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/4 inch in 12 feet (2 mm in 1 m).
 - 3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (2 mm in 1 m).
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.
- D. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.
- E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing handrails and railing systems and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Non-welded Connections: Use mechanical joints for permanently connecting railing components. Locate exposed fasteners in least conspicuous locations. Seal recessed holes of exposed locking screws with plastic filler, cement colored to match finish of handrails and railing systems.

- B. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact, or use fittings designed for this purpose.
- C. Expansion Joints: Install expansion joints at locations indicated but not further apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches (150 mm) of post.

3.4 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets and end fittings. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets and wall return fittings to building construction as follows:
 - 1. Use type of bracket with predrilled hole for exposed bolt anchorage.
 - 2. For concrete anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
 - 3. For wood stud partitions, use lag bolts set into wood backing between studs. Coordinate with stud installation to accurately locate backing members.
 - 4. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed anchors using self-tapping screws of size and type required to support structural loads.

3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

3.6 PROTECTION

- A. Protect finishes of handrails and railing systems from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Miscellaneous wood blocking and nailers.
 - 4. Plywood panels for backing and wainscoting.

1.3 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NLGA: National Lumber Grades Authority.
 - 2. WCLIB: West Coast Lumber Inspection Bureau.
 - 3. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated

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temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Wood-preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Engineered wood products.
 4. Power-driven fasteners.
 5. Powder-actuated fasteners.
 6. Expansion anchors.
 7. Metal framing anchors.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.
- B. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria":
1. Dimension lumber framing.
 2. Timber.
 3. Laminated veneer lumber.
 4. Parallel-strand lumber.
 5. Prefabricated wood I-joists.
 6. Rim boards.
 7. Miscellaneous lumber.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA C2.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

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2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWWA C27 (plywood).
 - 1. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat the following:
 - 1. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: 15 percent.
- B. Non-Load-Bearing Interior Partitions: No. 2 or better of the following species:
 - 1. Western woods; WCLIB or WWPA.
- C. Exterior and Load-Bearing Walls: No. 2 or better of the following species:
 - 1. Douglas fir-larch; WCLIB or WWPA.
- D. Ceiling Joists (Non-Load-Bearing): No. 2 or better of the following species:
 - 1. Western woods; WCLIB or WWPA.
- E. Joists, Rafters, and Other Framing Not Listed Above: No. 2 or better of the following species:
 - 1. Douglas fir-larch; WCLIB or WWPA.

2.5 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no urea formaldehyde.
 - 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. Boise Cascade Corporation.
 - b. Georgia-Pacific.
 - c. Louisiana-Pacific Corporation.
 - d. Pacific Woodtech Corporation.
 - e. Roseburg Forest Products Co.
 - f. Weyerhaeuser Company.

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- B. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Provide units complying with material requirements of and with structural capacities established and monitored according to ASTM D 5055.
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. Boise Cascade Corporation.
 - b. Georgia-Pacific.
 - c. Louisiana-Pacific Corporation.
 - d. Pacific Woodtech Corporation.
 - e. Roseburg Forest Products Co.
 - f. Weyerhaeuser Company.
 2. Provide I-joists manufactured without urea formaldehyde.
 3. Web Material: Either oriented strand board or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1.
 4. Structural Properties: Provide units with depths and design values not less than those indicated.
 5. Provide units complying with APA PRI-400, factory marked with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA standard.
- C. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.
1. Manufacturer: Provide products by same manufacturer as I-joists.
 2. Material: All-veneer product or product made from any combination solid lumber, wood strands, and veneers. Provide rim boards made without urea formaldehyde.]
 3. Thickness: 1-1/8 inches (28 mm).
 4. Provide performance-rated product complying with APA PRR-401, rim board grade, factory marked with APA trademark indicating thickness, grade, and compliance with APA standard.

2.6 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Furring.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content of the following species:
1. Western woods; WCLIB or WWPA.

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

2.7 PLYWOOD PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.
- B. Shop Wainscot Panels: Exposure 1, A-C Plugged, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.9 METAL FRAMING ANCHORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Products: Subject to compliance with requirements, provide Simpson Strong-Tie Co., Inc. products, or comparable.
- D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- E. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 - 1. Use for interior locations where stainless steel is not indicated.
- F. I-Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
- G. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches (57 mm) wide by 0.062 inch (1.6 mm) thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.

2.10 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

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- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- E. Do not splice structural members between supports, unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.
- H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

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3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.
 4. Table 2305.2, "Fastening Schedule," in BOCA's BOCA National Building Code.
 5. Table 2306.1, "Fastening Schedule," in SBCCI's Standard Building Code.
 6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's International One- and Two-Family Dwelling Code.
- K. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.
- L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
1. Comply with approved fastener patterns where applicable.
 2. Use finishing nails, unless otherwise indicated.

3.2 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction, unless otherwise indicated.
1. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

3.3 FLOOR JOIST FRAMING INSTALLATION

- A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches (38 mm) of bearing on wood or metal, or 3 inches (76 mm) on masonry.
- B. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches (102 mm) or securely tie opposing members together. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist over supports.
- C. Provide solid blocking between joists under jamb studs for openings.

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3.4 CEILING JOIST AND RAFTER FRAMING INSTALLATION

- A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
 - 1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- (19-by-184-mm actual-) size or 2-by-4-inch nominal- (38-by-89-mm actual-) size stringers spaced 48 inches (1200 mm) o.c. crosswise over main ceiling joists.
- B. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions, if any.

3.5 PROTECTION

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

END OF SECTION 061000

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Plastic-laminate cabinets.
 - 2. Recycled glass surfacing material for countertops and window sills.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Product Data: For panel products, high-pressure decorative laminate, cabinet hardware and accessories, finishing materials and processes.
 - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
 - 4. Apply WI-certified compliance label to first page of Shop Drawings.
- C. Samples for Initial Selection:
 - 1. Shop-applied transparent finishes.
 - 2. Plastic laminates.
 - 3. PVC edge material.
- D. Product Certificates: For each type of product, signed by product manufacturer.

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- E. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of products.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- D. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: Maple, plain sawn or sliced.
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a. Formica Corporation.
 - b. Lamin-Art, Inc.
 - c. Nevamar Company, LLC; Decorative Products Div.
 - d. Wilsonart International; Div. of Premark International, Inc.
- E. Recycled Glass Surfacing Material: Homogeneous solid sheets of recycled glass with Portland cement binder matrix.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "Vetrazzo" by Polycor or comparable product.
 - a. Compressive strength (ASTM C39): 6,295 psi.
 - b. Scratch Resistance (Mohs Hardness): 7.5 Glass / 4.75 Matrix.
 - c. Food Safety (NSF/ANDI 51): NSF splash zone certified.

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2. Thickness: 3-cm (1.18 inches)
3. Recycled glass content: 85% by weight.
4. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:
 1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Wire Pulls: Back mounted, solid metal 5 inches (127 mm) long, 1-1/4 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Drawer Slides: BHMA A156.9, B05091.
 1. Standard Duty (Grade 1, Grade 2, and Grade 3): Side mounted, full-extension zinc-plated steel with polymer rollers.
- G. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- H. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

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1. Wood Glues: 30 g/L.
2. Contact Adhesive: 250 g/L.

2.4 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).
 2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
- C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of openings in countertops with a coat of varnish.

2.5 PLASTIC-LAMINATE CABINETS

- A. Grade: Custom.
- B. AWI Type of Cabinet Construction: Flush overlay.
- C. Reveal Dimension: 1/2 inch (13 mm).
- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 1. Horizontal Surfaces Other Than Tops: Grade HGS.

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2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade HGS.
 4. Edges: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
- E. Materials for Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate.
 2. Drawer Sides and Backs: Thermoset decorative panels.
 3. Drawer Bottoms: Thermoset decorative panels.
- F. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- G. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Match Architect's sample.
 2. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, Wood grains, and Patterns, matte finish.
- 2.6 SHOP FINISHING
- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing opaque-finished architectural woodwork.
- D. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing architectural woodwork not indicated to be shop finished.
- E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require

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backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

- F. Transparent Finish:
 - 1. Grade: Custom
 - 2. AWI Finish System: Conversion varnish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips.

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- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
 - 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 066400 - PLASTIC PANELING

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 glass-fiber reinforced plastic (FRP) wall paneling.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For plastic paneling and trim accessories in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 200 or less.
 - 2. Smoke-Developed Index: 450 or less.
 - 3. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Marlite Symmetrix FRP, or pre-approved comparable product.
2. Nominal Thickness: Not less than 0.09 inch (2.3 mm).
3. Surface Finish: Smooth surface with filled grooves at 4 inches (102 mm) o.c. to resemble tile. Provide with Sani-Coat surface protection.
4. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide trim and base moldings and outside corners and caps as needed to conceal edges.
 1. Color: Match panels.
- B. Adhesive: As recommended by plastic paneling manufacturer.
- C. Sealant: Single-component, mildew-resistant silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- B. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches (300 mm) wide.
 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
 2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
 - 1. Do not use Division or inside corner trims. Provide sealant in gap between panels to form a grooved seam that matches the panel's scored grout lines.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

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SECTION 071113 - BITUMINOUS DAMPPROOFING

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. Cold-applied, emulsified-asphalt dampproofing.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.
- B. Material Certificates: For each product, signed by manufacturers.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- 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:

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ChemMasters Corp.
 - 2. Degussa Building Systems; Sonneborn Brand Products.
 - 3. Gardner Gibson, Inc.
 - 4. Henry Company.
 - 5. Karnak Corporation.
 - 6. Koppers Inc.
 - 7. Malarkey Roofing Products.
 - 8. Meadows, W. R., Inc.
 - 9. Tamms Industries, Inc.
- C. Trowel Coats: ASTM D 1227, Type II, Class 1.
- D. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- E. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
- F. VOC Content: 0.25 lb/gal. (30 g/L) or less.

2.2 MISCELLANEOUS MATERIALS

- A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
 - 1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
 - 2. Test for surface moisture according to ASTM D 4263.

3.2 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.
- C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections.

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3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
- B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior.
 - 1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches (150 mm) over outside face of footing.
 - 2. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. On Concrete Foundations: Apply 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or 1 trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

3.5 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 071113

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SECTION 071900 - WATER REPELLENTS

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 penetrating water-repellent coatings for the following vertical and horizontal surfaces:
 - 1. Concrete (unpainted).
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for curing compounds, curing and sealing compounds, and penetrating liquid floor treatments.
 - 2. Division 07 Section "Joint Sealants."
 - 3. Division 09 painting Sections for paints and coatings.

1.3 PERFORMANCE REQUIREMENTS

- A. Performance Testing: Provide water repellents that comply with test-performance requirements indicated, as evidenced by reports of tests performed by manufacturer by a qualified independent testing agency on manufacturer's standard products applied to substrates simulating those on Project using same application methods to be used for Project.
- B. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
 - 1. Concrete Unit Masonry: ASTM C 140.
 - 2. Hardened Concrete: ASTM C 642.
- C. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
- D. Permeability: Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, per ASTM D 1653.
- E. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
- F. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 154.
- G. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.

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1. Reduction of Water Absorption: 80 percent.
2. Reduction in Chloride Content: 80 percent.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. Include manufacturer's printed statement of VOC content.
- B. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1.6 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
 1. Ambient temperature is above 40 deg F (4.4 deg C).
 2. Concrete surfaces and mortar have cured for more than 28 days.
 3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.
 4. Rain or snow is not predicted within 24 hours.
 5. Application proceeds more than seven days after surfaces have been wet.
 6. Substrate is not frozen, or surface temperature is above 40 deg F (4.4 deg C).
 7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in Part 1 "Performance Requirements" Article within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 PENETRATING WATER REPELLENTS

- A. Silane, Penetrating Water Repellent: Clear, monomeric compound containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 3.3 lb/gal. (400 g/L) or less of VOCs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to water-repellent manufacturer's written instructions, to ensure that surface is dry enough.
 - 1. Cast-in-Place Concrete: Remove oil, curing compounds, laitance, and other substances that could prevent adhesion or penetration of water repellents.
- B. Test for pH level, according to water-repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.
- C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.
- D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

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- B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
- C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Perimeter foundation wall insulation.
 - 2. Concealed building insulation.
 - 3. Vapor retarders.
- B. Related Sections include the following:
 - 1. Division 03 Section "Concrete."
 - 2. Division 09 Section "Gypsum Board" for installation in metal-framed assemblies of insulation specified by referencing this Section.
 - 3. Division 13 Section "Metal Building Systems"

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.
- D. Research/Evaluation Reports: For foam-plastic insulation.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.

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3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 RIGID FOUNDATION PERIMETER INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, type IV, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively.
 1. Basis-of-Design Product: Styrofoam Scoreboard, Dow Chemical Company.
 2. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.3 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers:
 1. CertainTeed Corporation.
 2. Johns Manville.
 3. Owens Corning.
- B. Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III.
- C. Provide blankets in batt or roll form with thermal resistances indicated on drawings.

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2.4 VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils (0.15 mm) thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
- B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- C. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

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3.4 INSTALLATION OF PERIMETER INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder to warm side.
 - 1. Delete paragraph above and subparagraph below if no units are furnished with vapor-retarder faces.
 - 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
- E. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.6 INSTALLATION OF VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

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- B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (400 mm) o.c.
- C. Before installing vapor retarder, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
- D. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
- E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
- F. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.7 PROTECTION

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

END OF SECTION 072100

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SECTION 074113 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Standing-seam metal roof panels.
- 2. Flashings, counterflashings, gutters, and downspouts.

- B. Related Sections:

- 1. Division 07 Section "Metal Wall Panels" for factory-formed metal wall panels.
- 2. Division 07 Section "Joint Sealants"
- 3. Division 13 Section "Metal Building Systems" for matching roof panel products.

1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: Negative 1.57 lbf/sq. ft. (75 Pa) where roof slope less than or equal to 30 degrees.
 - 2. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft. (75 Pa) where roof slope greater than 30 degrees.
 - 3. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.

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4. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.
- C. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) where roof slope less than or equal to 30 degrees.
 2. Test-Pressure Difference: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12.0 lbf/sq. ft. (575 Pa) where roof slope greater than 30 degrees.
 3. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.
 4. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.
- D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.
- E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- F. Solar Reflectance Index (SRI) ASTM E1980-01: 29 or greater.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of roof panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
- C. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.
 1. Include similar Samples of trim and accessories involving color selection.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- E. Warranties: Samples of special warranties.

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1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- C. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

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1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
 2. Surface: Smooth, flat finish.
 3. Exposed Coil-Coated Finish:
 - a. Premium Fluoropolymer: Fluoropolymer finish containing not less than 70 percent Kynar 500, 1.0 mil minimum dry film thickness.
 4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Panel Sealants:
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed

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fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 METAL ROOF PANELS

- A. Panel: High profile mechanical seamed 3-inch tall Standing Seam with three pronounced stiffening ribs per panel.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "Seam Rib 324" by Fabral or pre-approved comparable product.
 - 2. Material: Minimum 24-gauge Galvalume/Zincalume conforming to ASTM A724/A792 for coating AZ50.
 - 3. Panel Coverage: 24-inches.
 - 4. Finish Coating: Polyvinylidene Fluoride with Kynar 500 finish
 - 5. Color: As selected by Architect from manufacturer's full line of colors.
 - 6. Refer to paragraph 1.6 D., above for color selection requirements
 - 7. Attachment: Concealed two-piece clip, allowing thermal movement.
 - 8. Uplift Rating: UL90.

2.4 ACCESSORIES

- A. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
 - 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - 3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum 0.018 inch (0.45 mm) thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.
- C. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (900 mm) o.c.,

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fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

- D. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Finish downspouts to match gutters.

2.5 FABRICATION

- A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. End Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. End Seams for Other Than Aluminum: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
- B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

3.3 METAL ROOF PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
 - 1. Install clips to supports with self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners

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where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
1. Provide elbows at base of downspouts to direct water away from building.
 2. Connect downspouts to underground drainage system indicated.
- E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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3.7 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

SECTION 074213 - METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal wall panels.
 - 2. Metal soffit panels
- B. Related Sections:
 - 1. Division 07 Section "Metal Roof Panels" for factory-formed metal wall panels.
 - 2. Division 07 Section "Joint Sealants"
 - 3. Division 13 Section "Metal Building Systems" for matching roof panel products.

1.3 DEFINITION

- A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- D. Water Penetration under Dynamic Pressure: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward-acting, wind-

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load design pressure of not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12 lbf/sq. ft. (575 Pa).

1. Water Leakage: As defined according to AAMA 501.1.
 2. Water Leakage: Uncontrolled water infiltrating the system or appearing on system's normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
- E. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure of 20 lbf/sq. ft. (957 Pa), acting inward or outward.
 - b. Uniform pressure as indicated on Drawings.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory, shop and field-assembled work.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 1. Metal Wall Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal wall panel accessories.
 2. Trim and Closures: 12 inches (305 mm) long. Include fasteners and other exposed accessories.
 3. Accessories: 12-inch- (305-mm-) long Samples for each type of accessory.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- E. Maintenance Data: For metal wall panels to include in maintenance manuals.

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- F. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of metal wall panel from single source from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal wall panel for period of metal wall panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

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1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
 2. Surface: Smooth, flat finish.
 3. Exposed Coil-Coated Finish:
 - a. Premium Fluoropolymer: Fluoropolymer finish containing not less than 70 percent Kynar 500, 1.0 mil minimum dry film thickness.
 4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Panel Sealants:
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

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2.2 MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.3 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.4 METAL WALL PANELS

- A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Panel: "RW" Type with full bearing leading edge rib, 1-1/2-inch trapezoidal rib and two stiffener ribs spaced 12 inches on center.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "Ultra-Rib" by Fabral or pre-approved comparable product.
 - 2. Material: Minimum 24 gauge, Galvalume/Zincalume conforming to ASTM A792 for coating AZ50.
 - 3. Panel Coverage: 36 inches.
 - 4. Finish Coating: Polyvinylidene Fluoride with Kynar 500 finish
 - 5. Color: As selected by Architect from manufacturer's full line of colors.
 - 6. Refer to paragraph 1.6 D., above for color selection requirements
 - 7. Attachment: Self-drilling, self-tapping, HWH screws with sealing washers through flat of panel.

2.5 METAL SOFFIT PANELS

- A. Panel: Concealed-Fastener Metal Soffit Panels formed with vertical panel edges with flush joint between panels; designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide "Select Series 12-R2" by Fabral or pre-approved comparable product.

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2. Material: Minimum 24-gauge Galvalume/Zincalume conforming to ASTM A724/A792 for coating AZ50.
3. Panel Coverage: 12-inches.
4. Panel Height: 1.5 inches.
5. Finish Coating: Polyvinylidene Fluoride with Kynar 500 finish
6. Color: As selected by Architect from manufacturer's full line of colors.
7. Refer to paragraph 1.6 D., above for color selection requirements
8. Attachment: Concealed two-piece clip, allowing thermal movement.

2.6 ACCESSORIES

- A. Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.018-inch (0.46-mm) minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.7 FABRICATION

- A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

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1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.
 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorages according to ASTM C 754 and metal wall panel manufacturer's written recommendations.
 1. Soffit Framing: Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal wall panels.
 2. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal wall panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 8. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 9. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners:
 1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.
 2. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized steel fasteners for surfaces exposed to the interior.

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- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.
 - 1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal wall panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 - 5. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.
 - 6. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps; on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weathertight.
 - 7. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to

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form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.
- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes sheet metal flashing and trim in the following categories:
 - 1. Exposed trim.
 - 2. Copings.
 - 3. Metal flashing.
 - 4. Reglets.
 - 5. Gutters for roof drainage.
 - 6. Downspouts connected to gutters.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 7 Roofing Sections for flashing and roofing accessories installed integral with roofing membrane as part of roofing-system work.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.

1.5 QUALITY ASSURANCE

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- A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

- A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

- A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ-50 coating, Grade 40 (ASTM A 792M, Class AZ-150 coating, Grade 275) or to suit project conditions, with 55 percent aluminum, not less than 0.0396 inch (1.0 mm) thick, unless otherwise indicated.
- B. High Performance Organic Coating Finish: Apply the following system by coil-coating process on galvanized steel sheet as recommended by coating manufacturers and applicator.
 - 1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulatd inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluorids resin by weight; complying with AAMA 605.2.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range of standard and custom choices for color and gloss.

2.2 REGLETS

- A. General: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces and compatible with flashing indicated.
- B. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
- C. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
- D. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of the counterflashing lower edge.
 - 1. Material: Galvanized steel, 0.0217 inch (0.55 mm) thick.

2.3 MISCELLANEOUS MATERIALS AND ACCESSORIES

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- A. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.
- B. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coat.
- C. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."
- D. Paper Slip Sheet: 5-lb/square (0.244 kg/sq. m) red rosin, sized building paper conforming to FS UU-B-790, Type I, Style 1b.
- E. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

2.4 FABRICATION, GENERAL

- A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- E. Expansion Provisions: Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

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- H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.
- I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
 - 1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.5 SHEET METAL FABRICATIONS

- A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.
- B. Scuppers and Conductor Heads: Fabricate from the following material:
 - 1. Pre-finished Aluminum-Zinc Alloy-Coated Steel: 0.0239 inch (24 gauge) thick.
- C. Exposed Trim: Fabricate from the following material:
 - 1. Pre-finished Aluminum-Zinc Alloy-Coated Steel: 0.0299 inch (22 gauge) thick.
- D. Counterflashing: Fabricate from the following material:
 - 1. Pre-finished Aluminum-Zinc Alloy-Coated Steel: 0.0239 inch (24 gauge) thick.
- E. Gutters: Fabricate from the following:
 - 1. Pre-finished Aluminum-Zinc alloy-coated steel: 0.1046 inch (12 gauge) thick.
- F. Downspouts: Fabricate from the following:
 - 1. Pre-finished Aluminum-Zinc alloy-coated steel: 0.0299 inch (22 gauge) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

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- B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- D. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
- E. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- F. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
- G. Install reglets to receive counterflashing according to the following requirements:
 - 1. Where reglets are shown in masonry, furnish reglets for installation under Division 4 Section "Unit Masonry."
- H. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches (50 mm) and bed with sealant.

3.3 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 076200

SECTION 078100 - APPLIED FIREPROOFING

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. Spray application of water based, intumescent, fireproofing on interior, structural steel to provide rated fireproofing.
- B. Related Sections include the following:
 - 1. Division 07 Section "Thermal Insulation" for fire-safing insulation.
 - 2. Division 07 Section "Penetration Firestopping" for fire-resistance-rated firestopping systems.

1.3 DEFINITIONS

- A. SFRM: Sprayed fire-resistive material.
- B. Concealed: Fire-resistive materials applied to surfaces that are concealed from view behind other construction when the Work is completed.
- C. Exposed: Fire-resistive materials applied to surfaces that are exposed to view when the Work is completed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Structural framing plans indicating the following:
 - 1. Locations and types of surface preparations required before applying SFRM.
 - 2. Extent of SFRM for each construction and fire-resistance rating, including the following:
 - a. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.

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3. Treatment of SFRM after application.
- C. Samples for Initial Selection: For each type of colored, exposed SFRM indicated.
- D. Product Certificates: For each type of SFRM, signed by product manufacturer.
- E. Qualification Data: For Installer, manufacturer, and testing agency.
- F. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating the following:
 1. Materials have been tested for bond with substrates.
 2. Materials have been verified by SFRM manufacturer to be compatible with substrate primers and coatings.
 3. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for proposed SFRM.
- H. Research/Evaluation Reports: For SFRM.
- I. Field quality-control test and special inspection reports.
- J. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by SFRM manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
- B. Source Limitations: Obtain SFRM through one source from a single manufacturer.
- C. SFRM Testing: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
 1. SFRMs are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Testing is performed on specimens of SFRMs that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.
 3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.

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- D. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.
1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with SFRM.
- E. Fire-Test-Response Characteristics: Provide SFRM with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify bags containing SFRM with appropriate markings of applicable testing and inspecting agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency acceptable to authorities having jurisdiction, for SFRM serving as direct-applied protection tested per ASTM E 119.
 2. Surface-Burning Characteristics: ASTM E 84.
- F. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to SFRM including, but not limited to, the following:
1. Review products, exposure conditions, design ratings, restrained and unrestrained conditions, calculations, densities, thicknesses, bond strengths, and other performance requirements.
 2. Review and finalize construction schedule and verify sequencing and coordination requirements.
 3. Review weather predictions, ambient conditions, and proposed temporary protections for SFRM during and after installation.
 4. Review surface conditions and preparations.
 5. Review field quality-control testing procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.
- B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

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1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply SFRM when ambient or substrate temperature is 40 deg F (4 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 COORDINATION

- A. Sequence and coordinate application of SFRM with other related work specified in other Sections to comply with the following requirements:
 - 1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
 - 2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
 - 3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
 - 4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
 - 5. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
 - 6. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 - 7. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
 - 8. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace SFRMs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than

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those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXPOSED INTUMESCENT MASTIC FIRE-RESISTIVE COATINGS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. Fire-Resistive, Water-Based, Intumescent Mastic Coating Material:
 - a. A/D Fire Protection Systems Inc.; Firefilm II and Colorcoat.
 - b. Albi Manufacturing, Division of StanChem Inc.; Albi Clad TF.
 - c. Carboline Company, Fireproofing Products Div.; Nullifire S607.
- B. Fire-Resistive, Intumescent Mastic Coating: Factory-mixed formulation.
 1. Water-Based Formulation: Approved by manufacturer and authorities having jurisdiction and investigated for Interior General Purpose by UL.
 2. Multicomponent system consisting of intumescent base coat and topcoat.
- C. Color and Gloss: As indicated by manufacturer's designations.

2.2 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with SFRM and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
 1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
 2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of SFRM per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of SFRM.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
- B. Verify that concrete work on steel deck has been completed.
- C. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.
- B. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.
- C. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM.
- D. For exposed applications, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of SFRM. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION, GENERAL

- A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

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- B. Apply SFRM that is identical to products tested as specified in Part 1 "Quality Assurance" Article and substantiated by test reports, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.
- C. Coat substrates with bonding adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by SFRM manufacturer for material and application indicated.
- D. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.
- E. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by SFRM manufacturer.
- F. Where sealers are used, apply products that are tinted to differentiate them from SFRM over which they are applied.

3.4 APPLICATION, EXPOSED INTUMESCENT MASTIC FIRE-RESISTIVE COATINGS

- A. Apply exposed intumescent mastic fire-resistive coatings in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition.
- B. Apply intumescent mastic fire-resistive coating as follows:
 - 1. Install reinforcing fabric as required to obtain designated fire-resistance rating.
 - 2. Finish: Even, spray-textured finish produced by lightly rolling flat surfaces of fire-protected members before fire-resistive material dries, to smooth out surface irregularities and to seal in surface fibers.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Tests and Inspections: Testing and inspecting of completed applications of SFRM shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of SFRM for the next area until test results for previously completed applications of SFRM show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
 - 1. Thickness for Floor, Roof, and Wall Assemblies: For each 1000-sq. ft. (93-sq. m) area, or partial area, on each floor, from the average of 4 measurements from a 144-sq. in.

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- (0.093-sq. m) sample area, with sample width of not less than 6 inches (152 mm) per ASTM E 605.
2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
 3. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
 4. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 10,000-sq. ft. (929 sq. m) area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.
 - a. Field test SFRM that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
 - b. If surfaces of structural steel receiving SFRM are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. (7.2 kPa) minimum per ASTM E 736.
 5. If testing finds applications of SFRM are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
- C. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.
- D. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

3.6 CLEANING, PROTECTING, AND REPAIR

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect SFRM, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at time of Substantial Completion.
- C. Coordinate application of SFRM with other construction to minimize need to cut or remove fire protection. As installation of other construction proceeds, inspect SFRM and patch any damaged or removed areas.
- D. Repair or replace work that has not successfully protected steel.

END OF SECTION 078100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and color Samples.
- B. Environmental Limitations: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F (4.4 deg C).

PART 2 - PRODUCTS

2.1 JOINT SEALANTS

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.
- B. Sealant for General Exterior Use Where Another Type Is Not Specified, One of the Following:
 - 1. Single-component, neutral-curing silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; Uses T, NT, M, G, A, and O.
 - 2. Single-component, nonsag urethane sealant, ASTM C 920, Type S; Grade NS; Class 25; and Uses NT, M, A, and O.
- C. Sealant for Use in Interior Joints in Plastic Paneling and Other Hard Surfaces in Kitchens and Toilet Rooms and Around Plumbing Fixtures:
 - 1. Single-component, mildew-resistant silicone sealant, ASTM C 920, Type S; Grade NS; Class 25; Uses NT, G, A, and O; formulated with fungicide.
- D. Sealant for Interior Use at Perimeters of Door and Window Frames:
 - 1. Latex sealant, single-component, nonsag, mildew-resistant, paintable, acrylic-emulsion sealant complying with ASTM C 834.

2.2 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer.

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- B. Cylindrical Sealant Backings: ASTM C 1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 1193.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Standard hollow metal doors and frames.
- B. Related Sections:
 - 1. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
 - 2. Division 08 Section "Glazing" for glazing in hollow metal doors and frames.
 - 3. Division 09 Painting Sections for field painting hollow metal doors and frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

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. Amweld Building Products, LLC.
 2. Ceco Door Products; an Assa Abloy Group company.
 3. Curries Company; an Assa Abloy Group company.
 4. Steelcraft; an Ingersoll-Rand company.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Division 08 Section "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 12.3 deg F x h x sq. ft./Btu (2.166 K x sq. m/W) when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors.
 3. Vertical Edges for Single-Acting Doors: Manufacturer's standard.
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
 5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
 6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
1. Fabricate frames with mitered or coped corners.
 2. Frames for Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
 3. Frames for Entrance System: 0.053-inch- (1.3-mm-) thick steel sheet.
- C. Interior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Frames for Steel Doors: 0.042-inch- (1.0-mm-) thick steel sheet.
3. Frames for Wood Doors: 0.042-inch- (1.0-mm-) thick steel sheet.
4. Frames for Borrowed Lights: Same as adjacent door frame.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where

practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 2. Glazed Lites: Factory cut openings in doors.
 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 6. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
 - b. Compression Type: Not less than two anchors in each jamb.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable glazing stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

DIVISION 8 - OPENINGS

- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Solid-core doors.
- 2. Factory finishing flush wood doors.
- 3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Sections:

- 1. Division 08 Section "Hollow Metal Doors and Frames" for metal frames for flush wood doors.
- 2. Division 08 Section "Door Hardware"

1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, and trim for openings.

- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

- 1. Indicate dimensions and locations of mortises and holes for hardware.
- 2. Indicate dimensions and locations of cutouts.
- 3. Indicate requirements for veneer matching.
- 4. Indicate doors to be factory finished and finish requirements.

- C. Samples for Initial Selection: For factory-finished doors.

- D. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

- B. Source Limitations: Obtain flush wood doors from single manufacturer.
- C. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
 - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- D. Forest Certification: Provide doors made with all wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

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. Vancouver Door
 2. Western Oregon Door
 3. Lynden

2.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- B. AWI Section 1300, Premium grade.
- C. Structural-Composite-Lumber-Core Doors:
1. Structural Composite Lumber: WDMA I.S.10.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
1. Grade: Premium, with Grade AA faces.
 2. Species: Select white maple.
 3. Cut: Plain sliced (flat sliced).
 4. Match between Veneer Leaves: Book match.
 5. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 6. Exposed Vertical Edges: Same species as faces or a compatible species.
 7. Core: Structural composite lumber.
 8. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Cut and trim openings through doors in factory.
1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Finish doors at factory where indicated in schedules or on Drawings as factory finished.
- C. Transparent Finish:
1. Grade: Premium.
 2. Finish: TR-6 catalyzed polyurethane.
 3. Staining: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
 - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Floor access doors and frames.

1.3 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

1.4 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.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The BILCO Company, P.O. Box 1203, New Haven, CT 06505; 1-203-934-6363, Fax: 1-203-933-8478, Web: www.bilco.com

2.2 ACCESS DOOR

- A. Furnish and install where indicated on plans floor access door Type T-1, size 24" width x 24" length. Access door shall be single leaf. The vault access door shall be pre-assembled from the manufacturer.
- B. Performance characteristics:
 - 1. Covers: Shall be reinforced to support a minimum live load of 150 psf (732 kg/m²) with a maximum deflection of 1/150th of the span.
 - 2. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

- C. Covers: Shall be ¼" (6.3 mm) aluminum smooth pattern plate with extruded aluminum molding. Molding shall be 1/8" in height, fastened to the cover to receive floor covering.
- D. Frame: Shall be 1/4" (6.3 mm) extruded aluminum with strap anchors bolted to the exterior.
- E. Hinges: Shall be specifically designed for horizontal installation and shall be bolted to the underside of covers.
- F. Lifting mechanisms: Cam-action hinges shall pivot on torsion bars to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing.
- G. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover.
- H. Hardware:
 - 1. Hinges: Cast steel cam-action hinges which pivot on torsion bars shall be provided.
 - 2. Covers shall be equipped with a steel hold open arm that automatically locks the cover in the open position.
 - 3. Covers shall be fitted with the required number and size of torsion bars.
 - 4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.
 - 5. Hardware: Shall be zinc plated and chromate sealed. Type 316 stainless steel hardware is available for installation in corrosive environments.
- I. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083613 – SECTIONAL DOORS

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 electrically operated sectional overhead doors.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports.
 - 2. Division 08 Section "Door Hardware" for lock cylinders and keying.
 - 3. Division 09 painting Sections for field-applied paint finish.
 - 4. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.
 - 2. Air Infiltration: Maximum rate not more than indicated when tested according to ASTM E 283.
 - a. Maximum Rate: 0.08 cfm (0.038 L/s) at 15 mph (24 km/h).
- B. Operation-Cycle Requirements: Provide sectional overhead door components and operators capable of operating for not less than 10,000 cycles.

1.4 SUBMITTALS

- A. Product Data: For each type and size of sectional overhead door and accessory. Include the following:
 - 1. Summary of forces and loads on walls and jambs.
 - 2. Motors: Show nameplate data and ratings, characteristics, and mounting arrangements.

- B. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's product data.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain sectional overhead doors through one source from a single manufacturer.
 - 1. Obtain operators and controls from sectional overhead door manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of sectional overhead doors and accessories and are based on the specific system indicated. Other manufacturers' systems with equal performance and dimensional characteristics may be considered. Refer to Division 01 Section "Product Requirements."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Doors with Insulated Steel Panels:
 - a. Overhead Door Corp.
 - b. Raynor.
 - c. Wayne-Dalton Corp.

2.2 STEEL DOOR SECTIONS

- A. Construct door sections including face sheets and frames from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with G60 (Z180) coating designation.
 - 1. Minimum Base-Metal (Uncoated) Thickness for Section Faces: 0.018 inch (0.45 mm).
 - 2. Exterior-Section Face: Manufacturer's standard flat, ribbed fluted.
- B. Fabricate door panels from a single sheet to provide sections not more than 24 inches (600 mm) high and nominally 2 inches (51 mm) deep. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.

1. For insulated doors, provide door sections with continuous thermal-break construction, separating faces of door.
- C. Enclose open sections with channel end stiles formed from not less than 0.064-inch- (1.6-mm-) thick galvanized steel sheet and weld end stiles to door section in place. Provide intermediate stiles formed from not less than 0.064-inch- (1.6-mm-) thick galvanized steel sheet, cut to door section profile, and welded in place.
1. Stile Spacing: Not more than 48 inches (1200 mm) apart.
- D. Reinforce bottom section with a continuous channel or angle complying with bottom-section profile and allowing installation of astragal.
- E. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.
- F. Provide reinforcement for hardware attachment.
- G. Thermal Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
1. Thermal Values: R-value of 17.50; U-value of 0.057.
 2. Inside Facing Material: Zinc-coated (galvanized) steel sheet with a minimum base (uncoated) metal thickness of 0.022 inch (0.55 mm).
- H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.
- I. Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean galvanized surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants.
 - a. Pretreat zinc-coated steel, after cleaning, with a conversion coating of type suited to organic coating applied over it.
 2. Apply manufacturer's standard primer and finish coats to interior- and exterior-door faces after forming, according to coating manufacturer's written instructions for application, thermosetting, and minimum dry film thickness.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized steel track system, sized for door size and weight, designed for lift type indicated and clearances shown, and complying with ASTM A 653/A 653M for minimum G60 (Z180) zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced at 2 inches (51 mm) apart for door-drop safety device. Slope tracks at proper angle from vertical or design to ensure tight closure at jambs when door unit is closed. Weld or bolt to track supports.

- B. Track Reinforcement and Supports: Galvanized steel track reinforcement and support members, complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
- C. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of overhead door.
 - 1. Provide continuous flexible seals at door jambs for a weathertight installation.
- D. Full-Vision Panels: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 6-mm-thick, clear acrylic glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.
- E. Exhaust Ports: Equip each door with manufacturer's standard exhaust port for vehicle exhaust evacuation.

2.4 HARDWARE

- A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty galvanized steel hinges of not less than 0.0747-inch- (1.9-mm-) thick, uncoated steel at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors exceeding 16 feet (4.87 m) in width, unless otherwise recommended by door manufacturer.
- C. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- (75-mm-) diameter roller tires for 3-inch- (75-mm-) wide track and 2-inch- (51-mm-) diameter roller tires for 2-inch- (51-mm-) wide track.
- D. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
 - 1. Locking Bars: Full-disc cremone type, both jamb sides operable from inside and outside.
- E. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.5 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from oil-tempered-steel wire complying with ASTM A 229/A 229M, Class II, mounted on a cross-header tube or steel shaft. Connect to door with galvanized aircraft-type lift cables with cable safety factor of at least 5 to 1. Provide springs calibrated for a minimum of 10,000 cycles.

- B. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level shaft and prevent sag.
- C. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.6 MANUAL DOOR OPERATORS

- A. Provide chain-hoists for manual operation of doors in the event of power loss.

2.7 ELECTRIC DOOR OPERATORS

- A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycle requirements specified, with electric motor and factory-rewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- B. Disconnect Device: Hand-operated disconnect device or mechanism for automatically engaging chain-and-sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect device and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- C. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
- D. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70, Class 2 control circuit, maximum 24-V, ac or dc.
- E. Door-Operator Type: Unit consisting of electric motor and the following:
 - 1. Heavy-duty 'V' belt and roller chain-and-sprocket primary drive with chain-and-sprocket secondary drive, and quick release for manual operation.
- F. Electric Motors: High-starting torque, reversible, continuous-duty, Class A insulated, electric motors complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction from any position, at not less than 2/3 fps (0.2 m/s) and not more than 1 fps (0.3 m/s), without exceeding nameplate ratings or service factor.
 - 1. Type: Polyphase, medium-induction type.
 - 2. Service Factor: Comply with NEMA MG 1, unless otherwise indicated.
 - 3. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
 - 4. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
 - 5. Provide totally enclosed, nonventilated or fan-cooled motor, fitted with plugged drain, and controller with NEMA ICS 6, Type 4 enclosure where indicated.
- G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."

1. Provide full-guarded, surface-mounted, heavy-duty-type interior unit with general-purpose, NEMA ICS 6, Type 1 enclosure.
- H. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
1. Pressure-Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Provide electrically actuated automatic bottom bar.
 - 1) Self-Monitoring Type: Four-wire configured device.
- I. Limit Switches: Adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install door, track, and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.
- B. Fasten vertical track assembly to framing, spaced not less than 24 inches (600 mm) apart. Hang horizontal track from structural overhead framing with angle or channel hangers fastened to framing by welding or bolting or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

3.2 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and with weathertight fit around entire perimeter.
- B. Touch-up Painting: Immediately after welding galvanized track to track supports, clean field welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

END OF SECTION 083613

SECTION 085113 - ALUMINUM WINDOWS

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 fixed and operable aluminum-framed windows for exterior locations.
- B. Related Sections include the following:
 - 1. Division 08 Section "Glazing" for glazing requirements for aluminum windows, including those specified to be factory- or site-glazed units.

1.3 DEFINITIONS

- A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
 - 1. HC: Heavy Commercial.
- B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
 - 1. Design pressure number in pounds force per square foot (pascals) used to determine the structural test pressure and water test pressure.
- C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
- D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified.
 - a. Basic Wind Speed: 85 mph (38 m/s).
 - b. Importance Factor: I.
 - c. Exposure Category: C.
- B. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of

joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
 1. Mullion details, including reinforcement and stiffeners.
 2. Joinery details.
 3. Expansion provisions.
 4. Flashing and drainage details.
 5. Weather-stripping details.
 6. Thermal-break details.
 7. Glazing details.
 8. Window System Operators: Show locations, mounting, and details for installing operator components and controls.
- C. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.
- D. Qualification Data: For Installer, manufacturer and testing agency.
- E. Field quality-control test reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.
- G. Maintenance Data: For operable window sash, weather stripping and finishes to include in maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

- C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.
- D. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Failure to meet performance requirements.
- b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
- c. Faulty operation of movable sash and hardware.
- d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
- e. Failure of insulating glass.

2. Warranty Period:

- a. Window: Three years from date of Substantial Completion.
- b. Glazing: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. EFCO Corporation.
 - 2. Milgard Manufacturing, Inc.
 - 3. Kawneer; an Alcoa Company.

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, not less than 16,000-psi (110-MPa) minimum yield strength, and not less than 0.062-inch (1.6-mm) thickness at any location for the main frame and sash members.
- B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
 - 1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch (3.2 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
 - 2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.
 - 1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/I.S.2/NAFS.
- F. Replaceable Weather Seals: Comply with AAMA 701/702.
- G. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 ALUMINUM WINDOWS

- A. Window Type: As indicated on Drawings.
- B. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS.
- C. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.

1. U-Factor: 0.46 Btu/sq. ft. x h x deg F (2.3 W/sq. m x K or less.
- D. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
1. Maximum Rate: 0.3 cfm/sq. ft. (5 cu. m/h x sq. m) of area at an inward test pressure of 1.57 lbf/sq. ft. (75 Pa).
- E. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test.
1. Test Pressure: 20 percent of positive design pressure, but not more than 15 lbf/sq. ft. (720 Pa).

2.4 GLAZING

- A. Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

2.5 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid bronze or non-magnetic stainless steel.
- B. Sill Cap/Track: Extruded-aluminum track with natural anodized finish, of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
- C. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
- D. Roller Assemblies: Low-friction design.
- E. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.
1. Operation Function: All ventilators move simultaneously and securely close at both jambs without using additional manually controlled locking devices.
- F. Limit Devices: Provide limit devices designed to restrict sash or ventilator opening.
- G. Horizontal-Sliding Windows: Provide the following operating hardware:
1. Sash Rollers: Nylon rollers.
 2. Sash Lock: Spring-loaded, snap-type lock at jambs; two per sash.
 3. Limit Device: Sash stop limit device; mounted in bottom of pull stile.

H. Projected Awning Windows: Provide the following operating hardware:

1. Operator: Gear-type rotary operator located on jamb at sill.
2. Hinge: Concealed four- or six-bar friction hinge located on each jamb near top rail; two per ventilator.
3. Lock: Cam action with latch on jamb.
4. Limit Device: Concealed limit device; located on jamb of each ventilator.

2.6 INSECT SCREENS

- A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside of window and provide for each operable exterior sash or ventilator.
- B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
- C. Aluminum Wire Fabric: 18-by-16 (1.1-by-1.3-mm) mesh of 0.011-inch- (0.28-mm-) diameter, coated aluminum wire.
 1. Wire-Fabric Finish: Black.

2.7 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
- D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.
 1. Horizontal-Sliding Windows: Provide operable sash with a double row of sliding weather stripping in horizontal rails and single- or double-row weather stripping in meeting or jamb stiles, as required to meet specified performance requirements. Provide compression-type weather stripping at perimeter of each movable panel where sliding-type weather stripping is not appropriate.
- E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- F. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.

- G. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
- H. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- (1.6-mm-) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.
- I. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.8 ALUMINUM FINISHES

- A. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

- F. Connect automatic operators to building electrical system.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and ventilators, screens, hardware, operators, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following:
 - 1. Hinges.
 - 2. Lock cylinders and keys.
 - 3. Lock and latch sets.
 - 4. Bolts.
 - 5. Exit devices.
 - 6. Push/pull units.
 - 7. Closers.
 - 8. Overhead holders.
 - 9. Miscellaneous door control devices.
 - 10. Door trim units.
 - 11. Protection plates.
 - 12. Weatherstripping for exterior doors.
 - 13. Thresholds.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 6 Section "Interior Architectural Woodwork" for cabinet hardware.
 - 2. Division 8 Section "Standard Steel Doors and Frames" for silencers integral with hollow metal frames.
 - 3. Division 8 Section "Flush Wood Doors" for factory prefitting and factory premachining of doors for door hardware.
 - 4. Division 8 Section "Aluminum Entrances and Storefronts" for aluminum entrance door hardware, except cylinders.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.

- B. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size, and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - e. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for hardware.
 - g. Door and frame sizes and materials.
 - h. Keying information.
 - 2. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.
 - 3. Keying Schedule: Submit detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- D. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Require supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.

- C. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.6 PRODUCT HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.7 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.2 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.
2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.
 - a. Butts and Hinges: ANSI/BHMA A156.1.
 - b. Bored and Preamsembled Locks and Latches: ANSI/BHMA A156.2.
 - c. Exit Devices: ANSI/BHMA A156.3.
 - d. Door Controls - Closers: ANSI/BHMA A156.4.
 - e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
 - f. Architectural Door Trim: ANSI/BHMA A156.6.
 - g. Template Hinge Dimensions: ANSI/BHMA A156.7.
 - h. Door Controls - Overhead Holders: ANSI/BHMA A156.8.
 - i. Interconnected Locks and Latches: ANSI/BHMA A156.12.
 - j. Mortise Locks and Latches: ANSI/BHMA A156.13.
 - k. Sliding and Folding Door Hardware: ANSI/BHMA A156.14.
 - l. Closer Holder Release Devices: ANSI/BHMA A156.15.
 - m. Auxiliary Hardware: ANSI/BHMA A156.16.
 - n. Materials and Finishes: ANSI/BHMA A156.18.

2.3 MATERIALS AND FABRICATION

- A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
- B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.
- C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

- E. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES AND BUTTS,

- A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Screws: Provide Phillips flat-head screws complying with the following requirements:
 1. For metal doors and frames install machine screws into drilled and tapped holes.
 2. For wood doors and frames install wood screws.
 3. For fire-rated wood doors install #12 x 1-1/4-inch (32-mm), threaded-to-the-head steel wood screws.
 4. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 1. Out-Swing Exterior Doors: Nonremovable pins.
 2. Out-Swing Corridor Doors with Locks: Nonremovable pins.
 3. Interior Doors: Nonrising pins.
 4. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) indicated.
- D. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90 inches (2250 mm) or less in height and one additional hinge for each 30 inches (750 mm) of additional height.
 1. Fire-Rated Doors: Not less than 3 hinges per door leaf for doors 86 inches (2150 mm) or less in height with same rule for additional hinges.

2.5 LOCK CYLINDERS AND KEYING

- A. Multiple-Building System: Except as otherwise indicated, provide new grandmasterkey system for Project.
- B. Equip locks with cylinders for interchangeable-core pin tumbler inserts. Furnish only temporary inserts for the construction period, and remove these when directed and install final cylinders.
- C. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.

- D. Comply with Owner's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
 - 1. Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE."
- E. Key Material: Provide keys of nickel silver only.
- F. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system.
 - 1. Furnish one extra blank for each lock.
 - 2. Deliver keys to Owner.

2.6 LOCKS, LATCHES, AND BOLTS

- A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.
 - 1. Provide flat lip strikes for locks with 3-piece, antifriction latchbolts as recommended by manufacturer.
 - 2. Provide recess type top strikes for bolts locking into head frames, unless otherwise indicated.
 - 3. Provide dust-proof strikes for foot bolts, except where special threshold construction provides nonrecessed strike for bolt.
- B. Lock Throw: Provide 5/8-inch (16-mm) minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
 - 1. Provide 1/2-inch (13-mm) minimum throw of latch for other bored and preassembled types of locks and 3/4-inch (19-mm) minimum throw of latch for mortise locks. Provide 1-inch (25-mm) minimum throw for all dead bolts.
- C. Flush Bolt Heads: Minimum of 1/2-inch- (13-mm-) diameter rods of brass, bronze, or stainless steel with minimum 12-inch- (300-mm-) long rod for doors up to 84 inches (2100 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2100 mm) in height.
- D. Exit Device Dogging: Except on fire-rated doors where closers are provided on doors equipped with exit devices, equip the units with keyed dogging device to keep the latch bolt retracted, when engaged.

2.7 PUSH/PULL UNITS

- A. Concealed Fasteners: Provide manufacturer's special concealed fastener system for installation, thru-bolted for matched pairs but not for single units.

2.8 CLOSERS AND DOOR CONTROL DEVICES

- A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use.
 - 1. Where parallel arms are indicated for closers, provide closer unit one size larger than recommended for use with standard arms.
- B. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.
- C. Provide grey resilient parts for exposed bumpers.

2.9 DOOR TRIM UNITS

- A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.
- B. Fabricate edge trim of stainless steel to fit door thickness in standard lengths or to match height of protection plates.
- C. Fabricate protection plates not more than 1-1/2 inches (38 mm) less than door width on hinge side and not more than 1/2 inch (13 mm) less than door width on pull side by height indicated.
 - 1. Metal Plates: Stainless steel, 0.050 inch (U.S. 18 gage) (1.3 mm).

2.10 HARDWARE FOR INTERIOR SLIDING DOORS

- A. General: Provide manufacturer's standard hardware for interior sliding doors when not furnished as part of complete door package.
- B. Operating Hardware for Pocket Doors: Provide manufacturer's complete set consisting of extruded aluminum or galvanized steel overhead track, adjustable hangers (carriages), galvanized steel split-jamb and split-studs, wood nailers for head track, jamb and studs, galvanized steel brackets for assembly and attachment to floor and wall framing, bumpers, and nylon floor guides designed to accommodate the number (single and biparting), size, thickness, and weight of door leaves indicated. Provide flush pull and edge pull for each door leaf.

2.11 WEATHERSTRIPPING AND SEALS

- A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.12 THRESHOLDS

- A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

2.13 HARDWARE FINISHES

- A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if no latch or lock sets).
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "no lacquer."
- D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.
- E. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.
 - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
 - 2. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers."
- F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
 - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

3.3 HARDWARE SCHEDULE

- A. General: Provide hardware for each door to comply with requirements of Section "Door Hardware," hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.
 - 1. Hardware sets indicate quantity, item, manufacturer and product designation, size, and finish or color, as applicable.
 - 2. Hardware sets indicate quantity, item, ANSI designation, size, and finish or color, as applicable.

MANUFACTURERS:

The numbers shown in the hardware groups are taken from the catalogs of the following manufacturers and are for the purpose of establishing quality, design, and function. Except as listed, no substitution will be allowed unless approved by the Architect ten days prior to bid opening. Only requests for substitution submitted by a distributor firm will be considered. No substitution will be allowed after bid opening.

The numbers			
ITEM		MANUFACTURER	APPROVED SUBSTITUTE
Butts		Stanley	Hager, McKinney
Gate Pivots		Bommer	McKinney
Locksets		Best	None
Cylinders		Best	None
Exit Devices		Von Duprin	Precision, Sargent
Push/Pull Units		Ives	Quality, BBW
Kick Plates		Ives	Quality, BBW
Pocket Door HW		Stanley	Johnson
Flushbolts		Ives	Quality, BBW
Closers		LCN	Norton 7500, Sargent 350
Wall Stops		Ives	Quality, BBW
Overhead Stops		Glynn Johnson	Rixson, ABH
Thresholds		Pemko	Reese, National Guard
Door Bottoms		Pemko	Reese, National Guard
Gasketing		Pemko	Reese, National Guard

HARDWARE GROUPS:

HW-1: Entrance/Exit (Doors 101A, 201)

3	Each	Hinges	CB1960 4.5 x 4.5	US26D NRP
1	Each	Lock	93K7R14D	626
1	Each	Closer	4111	Alum Lacq
1	Each	O.H. Stop	GJ450S	US26D
1	Each	Gasket	S88D	
1	Each	Door Bottom	18062CP	
1	Each	Threshold	271A x Pemkote	

HW-2: Entrance/Exit (Doors 101B, 107A)

3	Each	Hinges	CB1960 4.5 x 4.5	US26D NRP
1	Each	Lock	93K0N14D	626
1	Each	Closer	4111	Alum Lacq
1	Each	O.H. Stop	GJ450S	US26D
1	Each	Gasket	S88D	
1	Each	Door Bottom	18062CP	

DIVISION 8 - OPENINGS

HW-3: Office (Doors 102, 112A)

3	Each	Hinges	CB1900 4.5 x 4.5	US26D
1	Each	Lock	93K7AB14D	626
1	Each	Wall Stop	402-1/2 B	26D
3	Each	Silencer	20R	

HW-4: Office, 3-Hour Rating (Door 112B)

3	Each	Hinges	CB1900 4.5 x 4.5	US26D
1	Each	Lock	93K7AB14D	626
1	Each	Wall Stop	402-1/2 B	26D
1	Each	Gasket	S88D	
1	Each	Door Bottom	18062CP	
1	Each	Threshold	271A x Pemkote	

HW-5: Storage (Doors 105, 106)

3	Each	Hinges	CB1900 4.5 x 4.5	US26D
1	Each	Lock	93K7D14D	626
1	Each	Wall Stop	402-1/2 B	26D
3	Each	Silencer	20R	

HW-6: Privacy (Doors 109, 110, 111, 202)

3	Each	Hinges	CB1900 4.5 x 4.5	US26D
1	Each	Lock	93K0L14D	626
1	Each	Wall Stop	402-1/2 B	26D
3	Each	Silencer	20R	

HW-7: Entrance (Doors 113A, 113E)

3	Each	Hinges	CB1960 4.5 x 4.5	US26D NRP
1	Each	Lock	93K7R14D	626
1	Each	Closer	4111	Alum Lacq
1	Each	O.H. Stop	GJ450S	US26D
1	Each	Gasket	S88D	
1	Each	Door Bottom	18062CP	
1	Each	Threshold	271A x Pemkote	

HW-8: Storage, 3-Hour Rating (Door M102A)

3	Each	Hinges	CB1900 4.5 x 4.5	US26D
1	Each	Lock	93K7R14D	626
1	Each	Closer	4111	Alum Lacq
1	Each	O.H. Stop	GJ450S	US26D
3	Each	Silencer	20R	
1	Each	Gasket	S88D	

DIVISION 8 - OPENINGS

HW-9: Storage, 3-Hour Rating (Door M102B)

6	Each	Hinges	CB1900 4.5 x 4.5	US26D
1	Each	Flushbolts	358 B	26D
2	Each	Lock*	93K7D14D	626
1	Each	Gasket	S88D	
1	Each	Astragal	355CS	

*(NOTE: Lock lever on inside, blank plate on shop side)

HW-10: Entrance/Exit, 3-Hour Rating (Doors 107B, 114A)

3	Each	Hinges	CB1960 4.5 x 4.5	US26D NRP
1	Each	Lock	93K7R14D	626
1	Each	Closer	4111	Alum Lacq
1	Each	O.H. Stop	GJ450S	US26D
1	Each	Gasket	S88D	
1	Each	Door Bottom	18062CP	
1	Each	Threshold	271A x Pemkote	

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.1 SUMMARY

- A. Related Sections include the following:
 - 1. Division 08 Section "Hollow Metal Doors and Frames."
 - 2. Division 08 Section "Flush Wood Doors."

1.2 SECTION REQUIREMENTS

- A. Submittals: Product Data.
- B. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
- C. Insulating-Glass Certification Program: Permanently marked with certification label.

PART 2 - PRODUCTS

2.1 GLASS

- A. Heat-Treated Float Glass GL-1: ASTM C 1048, Type I, Class 1 (clear), Quality q3, Kind FT (fully tempered).
- B. Heat-Treated Float Glass GL-2: ASTM C 1048, Type I, Class 2 (tinted) bronze, Quality q3, Kind HS (heat strengthened).

2.2 FABRICATED GLASS PRODUCTS

- A. Sealed Insulating-Glass Units at Exterior Windows - IGU-1: Preassembled units complying with ASTM E 774 for Class CBA units, with two 6.0-mm thick sheets of glass separated by a 1/2-inch (12.7-mm) dehydrated space filled with argon.
 - 1. Inboard Lite: Clear Heat-Treated Float Glass (GL-1)
 - 2. Outboard Lite: Tinted Heat-Treated Float Glass (GL-2)
 - 3. Low-Emissivity Coating: Third surface.

4. Basis of Design: PPG Solarban 60 Solar-Control Low-E Glass with Bronze tint:
 - a. Ultraviolet Light Transmittance: 8%
 - b. Visible Light Transmittance: 41%
 - c. Visible Light Reflectance: 8%
 - d. U-value (Summer Daytime): 0.28 to 0.29 (winter)
 - e. Shading Coefficient: 0.37
 - f. Solar Heat Gain Coefficient: 0.32

- B. Sealed Insulating-Glass Units at Exterior Doors - IGU-2: Preassembled units complying with ASTM E 774 for Class CBA units, with two 6.0-mm- thick sheets of glass separated by a 1/4-inch dehydrated space filled with argon.
 1. Inboard Lite: Clear Heat-Treated Float Glass (GL-1)
 2. Outboard Lite: Tinted Heat-Treated Float Glass (GL-2)
 3. Low-Emissivity Coating: Third surface.
 4. Basis of Design: PPG Solarban 60 Solar-Control Low-E Glass with Bronze tint. Exterior door glazing shall match color and tint of exterior window glazing (IGU-1).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are contained in GANA's "Glazing Manual."
- B. Location of safety glazing shall comply with latest edition of the International Building Code, Section 2406 – Safety Glazing.
- C. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:
 - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
 - 2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).
- B. Related Sections include the following:
 - 1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.
 - 2. Division 07 Section "Thermal Insulation" for insulation installed with Z-shaped furring members.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - 2. Protective Coating: hot-dip galvanized, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.
- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.
 - 1. Depth: 2-1/2 inches (64 mm).
- D. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.
 - 2. Steel Studs: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
 - a. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 - 4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- E. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 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. Armstrong World Industries, Inc.
 - b. Chicago Metallic Corporation.
 - c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
 - 2. Depth: As indicated on Drawings.

- B. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (50.8-mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
- D. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

- 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

- 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

- 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

- C. Install bracing at terminations in assemblies.

- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings as required by referenced installation standards for assembly types and other assembly components indicated.

- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

- C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch (3 mm) in 3.6 m measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
 1. Space studs as follows: 16 inches (406 mm) o.c., unless otherwise indicated
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

D. Z-Furring Members:

1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced [24 inches (610 mm)] [600 mm] o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board.
- B. Related Sections include the following:
 - 1. Division 05 Section "Cold-Formed Metal Framing" for exterior steel framing that supports gypsum board.
 - 2. Division 06 Section "Sheathing" for gypsum sheathing.
 - 3. Division 06 Section "Plastic Paneling" for glass-fiber reinforced plastic (FRP) wall paneling installed over gypsum board.
 - 4. Division 07 Section "Thermal Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
 - 5. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
 - 6. Division 09 Painting Sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

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

1.4 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

- 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. G-P Gypsum.
 - b. USG Corporation.

- B. Type X:

- 1. Thickness: 5/8 inch (15.9 mm).
- 2. Long Edges: Tapered.

- C. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

- 1. Thickness: 1/2 inch (12.7 mm).
- 2. Long Edges: Tapered.

- D. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

- 1. Core: 5/8 inch (15.9 mm), Type X.
- 2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

- 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
- 2. Shapes:

- a. Cornerbead.
- b. LC-Bead: J-shaped; exposed long flange receives joint compound.
- c. L-Bead: L-shaped; exposed long flange receives joint compound.
- d. Curved-Edge Cornerbead: With notched or flexible flanges.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.

2. On partitions/walls, apply gypsum panels either vertically (parallel to framing) or horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 APPLYING TILE BACKING PANELS

- A. Water-Resistant Gypsum Backing Board: Install at showers, restrooms, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- F. Maintenance Data: For finishes to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
 2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264.
 - a. Smoke-Developed Index: 450 or less.
- C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580 and local jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels 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.

1.8 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. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong "Fine-Fissured" or a comparable product.
- B. Color: White.
- C. LR: Not less than 0.85.
- D. NRC: Not less than 0.70.
- E. Edge/Joint Detail: Beveled tegular.
- F. Thickness: 3/4 inch (19 mm).
- G. Modular Size: 24 by 24 inches (610 by 610 mm).
- H. Antimicrobial Treatment: BioBlock+.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.
- J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.
- K. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Prelude" by Armstrong, or a comparable product.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 9. Do not attach hangers to steel deck tabs.
 10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 11. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 3. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
 - 4. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
- B. Related Sections:
 - 1. Division 09 Section "Resilient Flooring" for resilient floor coverings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 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. Armstrong World Industries, Inc.
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Johnsonite.
 - d. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TV (vinyl, thermoplastic).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).
- E. Lengths: Coils in manufacturer's standard length.

- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Finish: As selected by Architect from manufacturer's full range.
- I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessories:
 - 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. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Flexco, Inc.
 - c. Johnsonite.
 - d. Roppe Corporation, USA.
- B. Description: Reducer strip for resilient floor covering, joiner for tile and carpet, and transition strips.
- C. Material: Vinyl.
- D. Colors and Patterns: As indicated by manufacturer's designations.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Cove Base Adhesives: Not more than 50 g/L.
 - b. Rubber Floor Adhesives: Not more than 60 g/L.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
- D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. Preformed Corners: Install preformed corners before installing straight pieces.
- G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096516 - RESILIENT FLOORING

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. Vinyl sheet floor covering
- 2. Recycled rubber tile floor covering

B. Related Sections:

- 1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of floor covering indicated.
- C. Qualification Data: For qualified Installer.
- D. Maintenance Data: For each type of floor covering to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive floor coverings during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than [55 deg F (13 deg C)] <Insert temperature> or more than [95 deg F (35 deg C)] <Insert temperature>.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install floor coverings after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Covering: Furnish quantity not less than 10 square feet for every 500 square feet or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

PART 2 - PRODUCTS

2.1 VINYL SHEET FLOOR COVERING <SV>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Relay RE" by Mannington Commercial or comparable product:
 - 1. Construction: Heterogeneous Sheet Flooring
 - 2. Size: 6' - (1.83m)
 - 3. Average Weight: 6.3 lbs / yd² * (3.37 Kg / m²)
 - 4. Pattern Repeat: Random Repeat, Reverse Sheet for Seaming
 - 5. Overall Thickness: 0.080 (2.03 mm)
 - 6. Wearlayer Thickness: 0.080 (2.03 mm)

7. Static Load Limit: 750 psi
8. ASTM Specification (F-1303): Exceeds
9. N.B.S. Smoke chamber Test (ASTM-E-662): <450 - Passes
10. Installation Adhesive Non-Porous Sub-floor V-95 / Full Spread
11. Recycled Content: 20% post-consumer and 15% pre-consumer recycled content.
12. Warranty: Limited Five Year Commercial Warranty

B. Seaming Method: Heat welded with manufacturer's recommended solid color weld rods.

C. Colors and Patterns: As selected by Architect from manufacturer's full range of colors.

2.2 RECYCLED RUBBER TILE FLOOR COVERING <RRF>

A. Basis-of-Design Product: Subject to compliance with requirements, provide "ECOsand" by ECOsurfaces or comparable product:

1. Construction: Non-laminated, single-ply, recycled rubber tile flooring
2. Material: 100% recycled SBR (Styrene-Butadiene Rubber) tire rubber, with bit-sized reprocessed EPDM rubber.
3. Tensile Strength (ASTM D412): 200 lb/in² min.
4. Flexibility (ASTM F137): pass 1/4" mandrel
5. Static Load Limit (ASTM F970): 400 lb/in² < 0.005 in.
6. Coefficient of Friction (ASTM D2047): > 0.9
7. Chemical Resistance (ASTM F925):
 - 5% Acetic Acid: no change
 - 70% Isopropyl Alcohol: no change
 - 5% Sodium Hydroxide: no change
 - 5% Hydrochloric Acid: no change
 - 5% Ammonia: no change
 - Bleach: no change
 - 5% Phenol: no change
 - Sulfuric Acid: no change
8. Noise Reduction Coefficient (ASTM C423): 0.05 sabine/ft²
9. Thermal Conductivity (ASTM C518): approximately 0.445 Btu-in/hr-ft²-°F
10. Impact Insulation Class (ASTM E492): 48
11. Sound Transmission Coefficient (ASTM E413): 51

B. Tile Dimensions: 36" x 36" with an overall thickness of 1/8" [3.2 mm].

C. Colors and Patterns: As selected by Architect from manufacturer's full range of colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.

1. Use adhesives that have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Seamless-Installation Accessories:
1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Color: Match floor covering.
- D. Integral-Flash-Cove-Base Accessories:
1. Cove Strip: 1-inch (25-mm) radius provided or approved by manufacturer.
 2. Cap Strip: Square metal provided or approved by manufacturer.
 3. Corners: Metal inside and outside corners and end stops provided or approved by manufacturer.
- E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

- D. Do not install floor coverings until they are same temperature as space where they are to be installed.
 - 1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.3 FLOOR COVERING INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor coverings.
- B. Unroll floor coverings and allow them to stabilize before cutting and fitting.
- C. Lay out floor coverings as follows:
 - 1. Maintain uniformity of floor covering direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in floor covering substrates.
 - 3. Match edges of floor coverings for color shading at seams.
 - 4. Avoid cross seams.
- D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.
- E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of floor coverings installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
 - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
 - 2. Chemically-Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly-fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.

J. Integral-Flash-Cove Base: Cove floor coverings 6 inches (152 mm) up vertical surfaces. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Perform the following operations immediately after completing floor covering installation:
 1. Remove adhesive and other blemishes from floor covering surfaces.
 2. Sweep and vacuum floor coverings thoroughly.
 3. Damp-mop floor coverings to remove marks and soil.
- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish for Vinyl Sheet Floor Covering: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
- E. Cover floor coverings until Substantial Completion.

END OF SECTION 096516

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation, painting and finishing of exposed interior and exterior items and surfaces, unless otherwise indicated.
 - 1. Do not paint pre-finished items, items with an integral finish, operating parts, and labels, unless otherwise indicated.
 - 2. Do not paint electrical panel faces except for panels in finished room areas shall be painted to match wall color.
 - 3. Owner reserves the right to independent special inspection of painting.
 - 4. Follow standards for subsurface preparation, products and application as required in the latest edition of the Master Painters Institute (MPI) Architectural Painting Specification Manual.

1.2 SUBMITTALS

- A. Product Data, Material Safety Data Sheets (MSDS), and "draw-down" Samples for each product and color select

1.3 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 1 gallon of each material and color applied. All extra materials shall be in new, unopened containers.

PART 2 - PRODUCTS

2.1 PAINT

- A. Available Manufacturer: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work will be limited to the following:
 - 1. ICI Paints.
 - 2. Benjamin Moore & Co.
 - 3. Sherwin-Williams
 - 4. Columbia Paint and Coatings
- B. VOC Content: All products to be used for interior finishes shall have low-odor/VOC content range of E3 as listed in MPI.

- C. Colors: Refer to Room Finish Schedule and Color Schedule in Drawings.
- D. Material Compatibility: Provide materials that are compatible with one another and with substrates.
- E. Material Quality: Manufacturer's best-quality paint material of coating types specified that are formulated and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove hardware, lighting fixtures and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.
- B. Clean and prepare all surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth

3.2 APPLICATION

- A. Apply coatings by brush, roller, spray or other applicators according to coating manufacturer's written instructions. Where primer and/or finished coats are applied by spray methods, then back rolling with long nap roller must follow.
- B. Pigmented (Opaque) Finishes: Completely cover surfaces to provide a light "orange peel" opaque texture of uniform appearance. Provide a finish free of cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections.

3.3 EXTERIOR PAINT APPLICATION SCHEDULE

A. Steel Substrates:

1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (gloss level - 6).

B. Galvanized-Metal Substrates:

1. Alkyd System: MPI EXT 5.3B.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (gloss level - 6).

3.4 INTERIOR PAINT APPLICATION SCHEDULE

A. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
 - a. Prime Coat: Rust-inhibitive primer (water based).
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (gloss level - 5).

B. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.
 - a. Prime Coat: Waterborne galvanized-metal primer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (gloss level - 5).

D. Stain on Finish Carpentry Substrates: Including architectural woodwork and doors, where scheduled.

1. Alkyd Varnish Over Stain and Sealer System: MPI INT 6.3D.
 - a. Stain Coat: Interior wood stain (semitransparent).

- b. Seal Coat: Alkyd sanding sealer.
- c. Two Finish Coats: Interior varnish (gloss level -3, 4 or 5).

E. Gypsum Board Substrates:

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (gloss level - 2).

3.5 CLEANING

- A. Cleanup: At the end of each day, remove empty cans, rags, rubbish and properly discard.
 - 1. After completing painting, clean glass and paint-splattered surfaces without any damage.

END OF SECTION 099100

SECTION 101400 - SIGNAGE

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. Panel signs.
- B. Related Sections include the following:
 - 1. Division 22 Section "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
 - 3. Division 26 Section "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
 - 4. Division 26 Section "Interior Lighting" for illuminated Exit signs.

1.3 CODE COMPLIANCE

- A. Comply with Washington State Building Code for Accessibility, WAC 51-30.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available.
- D. Sign Schedule: Use same designations indicated on Drawings.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

2.2 PANEL SIGNS

- 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. ASI-Modulex, Inc.
 - 2. Best Sign Systems Inc.
- B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:
 - 1. Panel: Acrylic Sheet
 - 2. Face: Vacuum formed 1.5 mil, clear, scratch resistant PVC/vinyl acetate bonded to panel.
 - 3. Edge Condition: Beveled.
 - 4. Corner Condition: Square.
 - 5. Mounting: Shim plate.
 - 6. Color: As selected by Architect from manufacturer's full range.
 - 7. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.

2.3 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.

2.4 FINISHES, GENERAL

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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

3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Shim Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Shower room accessories.
 - 2. Bathroom accessories.
 - 3. Underlavatory guards.
 - 4. Custodial accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated on Drawings.
 - 2. Identify products using designations indicated on Drawings.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.
- 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 accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 WASHROOM ACCESSORIES

- 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:

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- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. General Accessory Manufacturing Co. (GAMCO).
- D. Toilet Tissue (Roll) Dispenser:
1. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
 2. Mounting: Surface mounted.
 3. Operation: Noncontrol delivery with standard spindle.
 4. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- E. Paper Towel (Folded) Dispenser:
1. Mounting: Surface mounted.
 2. Minimum Capacity: 400 C-fold or 525 multifold towels.
 3. Material and Finish: Stainless steel, No. 4 finish (satin).
 4. Lockset: Tumbler type.
 5. Refill Indicators: Pierced slots at sides or front.
- F. Liquid-Soap Dispenser:
1. Description: Horizontal-Tank Type.
 2. Operation: Push-type valve for dispensing soap in liquid form.
 3. Mounting: Horizontally oriented, surface mounted.
 4. Capacity: 40 fluid ounce (1180 mL)
 5. Materials: Stainless steel piston, springs, and internal parts. Cover of type 304 stainless steel in No. 4 finish.
 6. Refill Indicator: Unbreakable, window type.
- G. Grab Bar:
1. Mounting: Flanges with concealed fasteners.
 2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4, satin finish.
 3. Outside Diameter: 1-1/2 inches (38 mm).
 4. Configuration and Length: As indicated on Drawings.
- H. Seat-Cover Dispenser:
1. Mounting: Surface mounted.
 2. Minimum Capacity: 250 seat covers.
 3. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
 4. Lockset: Tumbler type.

I. Mirror Unit:

1. Frame: Stainless-steel channel.
 - a. Corners: Manufacturer's standard.
2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
3. Size: As indicated on Drawings.

2.3 SHOWER ROOM ACCESSORIES

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. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.

B. Shower Curtain and Rod: Extra heavy-duty shower curtain rod, Type 304, stainless steel with satin finish. 18 gauge with 1-1/4" diameter for maximum 48-inch opening (field verify actual length.) Provide with Vinyl Shower Curtain and hooks. [This rod and curtain assembly is in addition to that provided with the Shower unit specified in the Mechanical specifications].
Basis-of-Design Products:

1. Rod: Bobrick B 6047
2. Curtain: Bobrick B 204-3
3. Hooks: Bobrick B 204-1

C. Towel Pin: Satin-finished, stainless steel hook projecting from wall surface; rectangular wall bracket with backplate for concealed mounting.

1. Product: Bobrick B 682

2.4 UNDERLAVATORY GUARDS

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. Plumberex Specialty Products, Inc.
2. TCI Products.
3. Truebro, Inc.

- B. Underlavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded-plastic, white.

2.5 CUSTODIAL ACCESSORIES

- 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. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
- B. Mop and Broom Holder: 0.05 inch (1.3 mm), Type 304, stainless steel hat channel with spring-loaded, rubber, cam-type mop/broom holders. Provide unit 36 inches (900 mm) long and complete with four holders.
 - 1. Basis-of-Design Product: Bobrick B 223.

2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire extinguishers.
2. Cabinets.

B. Related Sections:

1. Division 09 Painting Sections for field painting fire protection specialties.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include door hardware, cabinet type, trim style, panel style, and details of installation.

B. Submit manufacturer's operation and maintenance data. Include test, refill or recharge schedules, procedures, and re-certification requirements.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

C. Provide fire extinguishers, cabinets, and accessories from a single manufacturer.

PART 2 - PRODUCTS

2.1 EXTINGUISHERS

A. General: Provide fire extinguishers for each cabinet and other locations indicated.

1. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher indicated and with plated or baked-enamel finish.
2. Identification: Lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as directed by Architect.

B. Multi-Purpose Dry Chemical Type: Heavy Duty DOT Steel tank; UL rating 4A-60B:C, 10 lb capacity, with pressure gage; red enamel finish; metal valves and siphon tubes.

2.2 CABINETS

- A. Basis-of-Design Product: The design for fire extinguisher cabinets is based on listed products manufactured by Larsen's Manufacturing Company. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
 - 1. JL Industries, Inc.
 - 2. Potter Roemer; Div. of Smith Industries, Inc.
- B. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
 - 1. Acceptable Product: Provide Larsen's Model #2409.
- C. Furnish sizes as necessary to accommodate extinguishers.
- D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
 - 1. Trim: Formed Sheet Steel, minimum 20 gage; 2-1/2 inch rolled edge.
- E. Door: Larsen "Vertical Duo," with "Larsen-Loc" emergency cylinder lock, continuous hinge; and clear glass vision panel.
- F. Cabinet Finishes:
 - 1. Cabinet Trim and Door: Manufacturer's standard primed finish to receive paint coatings as specified in Section 09900.
 - 2. Cabinet Interior: Manufacturer's standard white epoxy or white baked enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cabinets plumb and level in wall openings and secured to framing in locations as indicated. Unless otherwise indicated, install 30 inches from finished floor to inside bottom of cabinet.
- B. Install fire extinguisher in each fire extinguisher cabinet by brackets mounted at back of cabinet.
- C. Where fire extinguishers are indicated for wall mounting, secure bracket to wall through finish to framing or blocking.
- D. Fire extinguishers shall be installed, charged, tagged, and dated, not more than 30 days prior to building turnover.
- E. Adjust cabinet doors that do not swing or operate freely.

END OF SECTION 104400

SECTION 105113 - METAL LOCKERS

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. Athletic metal lockers.
 - 2. Locker benches.

1.3 DEFINITIONS

- A. Uncoated Steel Sheet Thicknesses: Indicated as the minimum thicknesses.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show base, sloping tops, filler panels, recess trim and other accessories.
 - 2. Include locker identification system.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Qualification Data: For Installer.
- E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.

- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal lockers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with ICC A117.1. and FED-STD-795, "Uniform Federal Accessibility Standards."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for metal locker installation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:
 - 1. Concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed.
 - 2. Recessed openings.
 - 3. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish recessed opening dimensions and proceed with fabricating metal lockers without field measurements. Coordinate wall and floor construction to ensure that actual recessed opening dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for All-Welded Metal Lockers: Lifetime from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below, before construction begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than 5 units:
 - a. Locks.
 - b. Identification plates.
 - c. Hooks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.
- B. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.
- C. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.
- D. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.
 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.
 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 ALL-WELDED, ATHLETIC METAL LOCKERS

- A. Available Products:

1. All-Welded, Athletic Metal Lockers:
 - a. Art Metal Products, Div. of Fort Knox Storage Co.
 - b. Lyon Workspace Products.
 - c. Republic Storage Systems Company.
- B. Locker Arrangement: Single tier.
- C. Size: 15" wide x 18" deep x 72" tall.
- D. Body: Assembled by welding body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
 1. Tops and Bottoms: 0.0528 inch (1.35 mm) thick, with single bend at edges.
 2. Backs: 0.0428 inch (1.1 mm) thick.
 3. Shelves: 0.0528 inch (1.35 mm) thick, with double bend at front and right-angle single bend at sides and back.
- E. Unperforated Sides: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.
- F. Frames: Channel formed; fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet or 0.0966-inch- (2.5-mm-) thick steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
- G. Locker Base: Structural channels, formed from cold-rolled steel sheet; welded to front and rear of side-panel frames.
- H. Perforated Doors: One-piece, fabricated from 0.0677-inch- (1.7-mm-) thick, cold-rolled steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point (bottom) and right-angle single bend at remaining edges for box lockers.
 1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
- I. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
 1. Hinges: Manufacturer's standard, steel continuous or knuckle type.
- J. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.
 1. Single-Point Latching: Nonmoving latch hook with steel padlock loop that projects through recessed cup and is finished to match metal locker body.
 - a. Latch Hook: Equip each door with 1 latch hook, fabricated from minimum 0.1116-inch- (2.8-mm-) thick steel; welded midway up full-height door strike; with resilient silencer.

- K. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
 2. Coat Rods: For each compartment of metal lockers.
- L. Accessories:
1. Continuous Base: 4 inches (102 mm) high; fabricated from 0.0677-inch- (1.7-mm-) thick, cold-rolled steel sheet.
 2. Continuous Sloping Tops: Fabricated from minimum 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet; approximately 20-degree pitch.
 3. Recess Trim: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.
 4. Filler Panels: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.
 5. Boxed End Panels: Fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet.
- M. Finish: Baked enamel or powder coat.
1. Color(s): As selected by Architect from manufacturer's full range.

2.4 LOCKER BENCHES

- A. General: Provide locker benches fabricated by same manufacturer as metal lockers.
- B. Bench Tops: Manufacturer's standard 1-piece units, of the following material, minimum 9-1/2 inches (240 mm) wide by 1-1/4 inches (32 mm) thick, with rounded corners and edges:
1. Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.
- C. Freestanding Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top; complete with fasteners, and as follows:
1. Stainless Steel: 1/8-inch-thick by 3-inch- (3-mm-thick by 76-mm-) wide channel or 1/4-inch-thick by 3-inch- (6-mm-thick by 76-mm-) wide bar stock, shaped into trapezoidal form; with nonskid pads at bottom.

2.5 FABRICATION

- A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.

2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.

B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections, with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

E. Continuous Base: Formed into channel or Z profile for stiffness, and fabricated in lengths as long as practicable to enclose base and base ends of metal lockers; finished to match lockers.

F. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.

1. Sloped top corner fillers, mitered.

G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip joint filler angle formed to receive filler panel.

H. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.6 STEEL SHEET FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

D. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

E. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
- B. All-Welded Metal Lockers: Connect groups of all-welded metal lockers together with standard fasteners, with no exposed fasteners on face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Attach filler panels with concealed fasteners. Locate fillers panels where indicated on Drawings.
 - 4. Attach sloping top units to metal lockers, with closures at exposed ends.
 - 5. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.
- D. Fixed Locker Benches: Provide not less than 2 pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.
- E. Freestanding Locker Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.

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- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

END OF SECTION 105113

SECTION 119000 - SHOP SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of shop service equipment:
 - 1. Overhead Lubrication Hose Reel Unit.
 - 2. Lubrication tanks.
 - 3. Grease Dispensing Module.
 - 4. Multiple Tank Lubrication Dispensing Rack Unit.
 - 5. Equipment accessories required for the above for a complete and operational system.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. For Air Compressors and distribution, see Division 22 Sections.
 - 2. Electrical service is specified in Division 26.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each equipment item required, including the manufacturer's standard details and installation and maintenance instructions.
- C. Shop drawings for each item of equipment required for installation. Include plans, elevations, and details of typical components required for installation, including required connections for air and power. Show layout and installation details, including anchorage details.
- D. Maintenance data for equipment and components for inclusion in the Operating and Maintenance Manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who is an authorized representative of the equipment manufacturer for both installation and maintenance of the type of units required

for this Project, and whose installations have resulted in construction with a record of successful in-service performance.

- B. Design Concept: This section specifies equipment based on the specific type and models indicated. Individual components by other manufacturers may be considered provided deviations in dimensions and performance are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

1.5 WARRANTY

- A. Equipment Warranty: Submit manufacturer's standard written warranty, available for each equipment item indicated, executed by the manufacturer, agreeing to repair or replace equipment and/or components that fail in material or workmanship within the manufacturer's standard warranty period.
 - 1. Warranty period starts from date established on Certificate of Substantial Completion.
- B. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following (no substitutions are allow unless specifically stated):
 - 1. Overhead Lubrication Hose Reel Unit: Graco, Inc.
 - 2. Lubrication Tanks: Hoover Group, Inc.
 - 3. Grease Dispensing Module: Graco, Inc.
 - 4. Multiple Tank Lubrication Dispensing Rack Unit: Sauk Valley Equipment Co.

2.2 OVERHEAD LUBRICATION SYSTEM

- A. General: Provide overhead bracket mounted service unit with 5-hose reels to dispense air, water, grease and 2-separate lubricates. Provide all accessories required for a complete installation ready for the Owner's operational use.
- B. Overhead lubrication hose reel unit and accessories shall include, but not be limited to the following:
 - 1. Open dispensing reel and hose with air chuck for air dispensing: Graco part No. 224-352 with 3/8 inch x 60 ft. hose.
 - 2. Open dispensing reel and hose with water chuck for water dispensing: Graco part No. 224-354 with 3/8 inch x 60 ft. hose.

3. Open dispensing reel and hose with dispense valve for grease: Graco part No. 224-366 with 3/8 inch x 50 ft. hose and with grease dispense valve.
4. Two open dispensing reels for oil/gear lubrication, each with 1/2 inch x 50 ft. hose and dispense valves: Graco part No. 224-382 with electronically-metered dispense valves, in-line style, rigid extension.
5. Accessories shall include, but not limited to: Reel mounting brackets, mounting kits and channels, required fittings, swivels, air regulators, air shut-off valves, double ball check oil pumps, suction tubes, low-level cut-offs, needle valves, adapters, level gages, vents, dust caps, combination filter/regulator/pressure gage/lubricator unit, fluid shut-off valves and pressure relief valves.

2.3 LUBRICATION TANKS

- A. General: Provide 2 - 275 to 280 gallon double wall steel tanks for overhead lube unit, UL - listed steel tanks with sight gauge for overhead lube unit, with all required fittings.

2.4 GREASE DISPENSING MODULE

- A. General: Provide Graco pump, part No. 225-014, with all required fittings and accessories for connection to 120 lb. grease drum and overhead reel dispenser unit.

2.5 MULTIPLE LUBRICATION TANK DISPENSING RACK

- A. General: Provide horizontal 6-tank, lubrication dispensing system with metal rack and inboard console, complete with all accessories needed for a fully functional unit, ready for the Owner's operation.
 1. Lubrication dispensing rack shall include 6 - 65 gal. containers (2-rows of 3-containers) mounted on steel supporting rack, 110 volt transfer pump system, inboard spill containment console, and product delivery hose and valves.
 2. Provide product identification kit with labels for tanks and at dispenser, special product package, provide oil absorbent unit mounted to rack.
 3. Provide Model number HDI - 6-076132 by Sauk Valley Equipment Co.

2.6 ACCESSORIES

- A. General: Provide anchor bolts and other accessory items as required for a complete installation and operation for each type of equipment indicated for ready-to-use operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to beginning equipment installation, examine areas to receive equipment. Verify that critical dimensions are correct and that conditions are acceptable.

1. Do not proceed with installation of equipment until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide templates for anchor bolts and other items encased in concrete or masonry or below finished surfaces in sufficient time so as not to delay the Work.
- B. Coordinate and provide information required for mechanical and electrical connections to the equipment, supplied under this section, with Division 15 and 16 work.

3.3 INSTALLATION

- A. General: Install equipment in accordance with the manufacturer's instructions and placement drawings. Provide a complete installation with all required accessories and connections, for each equipment unit, ready for operation by the Owner.

3.4 CLEANING

- A. After installation clean finished surfaces. Touch up damaged shop-applied finishes as required to restore damaged areas.

END OF SECTION 119000

SECTION 122113 - HORIZONTAL LOUVER BLINDS

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 horizontal louver blinds with aluminum slats.
- B. Related Sections:
 - 1. Division 01 Section "Operation and Maintenance Data."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.
- C. Refer to Section "Operation and Maintenance Data" for additional requirements for the operations and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame-Resistance Ratings: Passes NFPA 701.
- C. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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. Horizontal Louver Blinds: Before installation begins, for each size, color, texture, pattern, and gloss indicated, full-size units equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hunter Douglas.
 - 2. Levolor, a Newell Rubbermaid Company.
- B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.
 - 1. Width: 1 inch (51 mm).
 - a. Spacing: Manufacturer's standard.
 - 2. Thickness: Manufacturer's standard.
 - 3. Finish: One color.
 - a. Reflective Coating: Manufacturer's special coating enhancing the reflection of solar energy on the outside-facing slat surface.
- C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs and the following:
 - 1. Capacity: One blind per headrail.
 - 2. Integrated Headrail/Valance: Curved face.
 - 3. Light-blocking lower back lip.

- 4. Tilt limiter with preselected degree settings.
- D. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends bottom contoured for minimizing light gaps; with enclosed ladders and tapes to prevent contact with sill.
- E. Ladders: Evenly spaced to prevent long-term slat sag.
 - 1. For Blinds with Nominal Slat Width 1 Inch (25 mm) or Less: Braided string.
- F. Lift Cords: Manufacturer's standard.
- G. Tilt Control: Enclosed worm-gear mechanism, and linkage rod, and the following:
 - 1. Tilt Operation: Manual with clear plastic wand.
 - 2. Tilt: Full.
- H. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.
- I. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
- J. Side Channels and Perimeter Light Gap Seals: Manufacturer's standard.
- K. Colors, Textures, Patterns, and Gloss: As selected by Architect from manufacturer's full range.

2.2 HORIZONTAL LOUVER BLIND FABRICATION

- A. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - 1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
- B. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Blind Units Installed between (inside) Jamb: Width equal to 1/4 inch (6 mm) per side or 1/2 inch (13 mm) total, plus or minus 1/8 inch (3.1 mm), less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm), less than head-to-sill dimension of opening in which each blind is installed.
- C. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail and operating hardware, and for hardware position and blind mounting method indicated.
- D. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- E. Color-Coated Finish:

1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- F. Component Color: Provide rails, cords, ladders, and exposed-to-view metal and plastic matching or coordinating with slat color, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 1 inch (25 mm) to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.
- B. Head Mounted: Install headrail on face of opening head.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean horizontal louver blind surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged horizontal louver blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122113

SECTION 13 30 00 - FUEL TANKS AND DISPENSING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Relocation of two existing double-wall, ballistic rated Fuel Tanks and their associated Dispensing Systems. Existing components are located at the current Landfill entrance area and shall be moved to the new Fuel Dispensing area near the new Shop Building.
 - a. Relocation of above Ground Fuel Tanks.
 - b. Fuel Dispensing.
 - c. Fuel Piping
 - d. Accessories

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Wiring diagrams detailing wiring for equipment, differentiating clearly between manufacturer-installed wiring and field-installed wiring.
 - 1. Show the locations of connections to electrical service provided as a unit of work under other Sections.
- C. Maintenance Instructions: Provide the manufacturer's instructions for maintenance of fuel dispensing equipment and components.
 - 1. Include recommended methods and frequency for maintaining equipment in optimum operating condition under anticipated traffic and use conditions.
 - 2. Include precautions against materials and methods that may be detrimental to finishes and performance.

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The fuel system installation contractor shall be a licensed tank services provider, currently registered with the Department of Ecology.

2. A DOE licensed tank services supervisor shall be present, on site, during all of the following phases of tank installation:
 - a. Any movement of the tank, including but not limited to transferring the tank from the transport vehicle.
 - b. Setting of the tank and associated piping, including placement of anchoring devices.
 - c. Placement and connection of the piping system to the tank.
 - d. All pressure testing of the tank and piping system.
3. A licensed electrical contractor must install and connect all related electrical wiring.

B. Regulatory Standards governing fuel system installation:

1. Comply with all regulatory Codes, ordinances, guidelines, etc., that are pertinent to this project's location and the manufacture and installation of above-ground fuel storage tanks.
2. ASTM standard document number D4021-86.
3. Underwriters Laboratories, Inc. (U.L.) standard for safety 1316, File MH 9061 for storage of flammable liquids.
4. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 30: Flammable and Combustible Liquids Code
 - b. NFPA 30A: Automotive and Marine Service Station Code

1.5 GENERAL REQUIREMENTS

- A. Other than the salvaged tanks and dispensing pumps, all equipment and materials provided shall be new, un-used, UL-approved for the intended use and, unless specifically identified otherwise, the manufacturer's latest model.
- B. The Contractor shall warranty all equipment and materials for operation and workmanship for one (1) year after Substantial Completion.
- C. The Contractor shall provide all electrical wiring, conduits, and other components and connections associated with the entire system that are required to make the fueling system fully operational, even if not specifically detailed. Upon completion of work, the fuel tank and dispensing system shall be operating in a manner complying with regulatory requirements and consistent with industry standards.
- D. Upon completion of the work, the site must be in full compliance with all federal, state and local regulations for the type of fueling system provided. Any inspections required by authorities having jurisdiction shall be scheduled and coordinated by the Contractor. Certification, when required by such authorities, shall be obtained by the Contractor and submitted to the Owner.
- E. The Contractor shall obtain all required permits prior to beginning work. Cost for all work, including permits, inspections, certifications, etc. shall be the responsibility of the Contractor.

PART 2 - PRODUCTS

2.1 ABOVE-GROUND TANKS

- A. The Existing Above-Ground Fuel Storage Tanks shall be relocated, following all regulatory requirements currently enforced in the State of Washington. Tanks shall be de-gassed and cleaned prior to moving. Installation of the tanks in their new location shall be in conformance with industry standards for a complete and operational fueling system. All required Certifications shall be obtained.
1. The number and general location of tanks are indicated on the Site Plan.
 - a. The two (2) existing tanks shall be placed and anchored to a Class 3000 concrete support slab which meets manufacturer recommendations for overall size, thickness and reinforcement. Minimum thickness on concrete shall be 12-inch thick slab reinforced with #4 rebar at 12-inches on center, each way, for bottom layer and #3 rebar at 18-inches on center, each way, for the top layer.
 2. Tank and/or tank assembly shall meet the following criteria:
 - a. The existing tanks and layout configuration shall be maintained in the new location. Maintain all existing components and upgrade items, connections, and/or anchorage only as required by current codes and regulations. Costs for any such modification/upgrade shall be included in submitted Bid. New piping must be installed and tested to comply with requirements of new construction.
 - b. Provide two 2" conduits between the main Shop Building and Fuels Tanks for future wiring of leak detection at tanks, pumps and spill buckets. Coordinate exact termination locations of conduits with Owner and provide seal fittings at both ends of run.
 - c. Tank Finish: All external tank surfaces to receive a new coating of commercial polyurethane paint, after proper manufacturer recommended preparation, including scraping and sanding as necessary.
 - d. Provide a 30-year warranty for all tanks

2.2 FUEL DISPENSING

- A. Dispensers
1. Fuel dispensers shall be single product dual hose and include the following standard features:
 - a. Mechanical registers with power reset interlock and four digit readout with and tenths on both front and back of cabinet. Provide with lighted display.
 - b. Totalizer with seven digit non-resetting readout on the front of cabinet.
 - c. Positive displacement meter tested and calibrated for accuracy at any speed or pressure.
 - d. Maximum working pressure rating of 50 psi.
 - e. Underwriters Laboratory listed

2. Gasoline dispenser shall be vapor ready, suitable for future Stage II upgrade, and shall include:
 - a. 5.0 gpm minimum capacity at dispenser
 - b. 3/4" x 15' reinforced wire braid hose
 - c. Hose breakaways
 - d. Swivel and automatic shut off nozzle (black).
 - e. Factory finished "Red" panels.
 3. Diesel dispenser shall include:
 - a. 10.0 gpm minimum capacity at dispenser
 - b. 1" x 30' reinforced wire braid hose
 - c. Hose breakaways
 - d. Swivels and automatic shut off nozzle (green).
 - e. Factory finished "Green" panels.
 4. Provide Bennett 4000 pumps and dispensing system for compatibility with other County-operated dispensing systems.
- B. Spill/Over-Fill Containment
1. Provide containment at all fill locations, pump locations, and piping transition locations.
- C. Shut-off and safety valves
1. A 2" ball valve shall be provided at each turbine to provide manual piping shut off.
 2. A 1½ " safety valve shall be installed under each dispenser and will include:
 - a. Fusible link to close poppet in the event of fire
 - b. Shear section to close poppet if the dispenser is knocked loose
 - c. Stabilizer bar assembly to secure valve
 - d. UL Standard 842 conformance

2.3 FUEL MANAGEMENT SYSTEM

- A. An electronic fuel management system will be furnished and installed by the Owner under separate contract.
1. Management system will be manufactured by "Trak Fuel Management Systems". The system will provide a key-operated control pedestal mounted on the fuel island.
- B. Work performed by Fuel System contractor shall include installation of a mounting base that is compatible with the pedestal unit and shall also include the termination of conduits to a pull box/base for connection to the key control pedestal.
1. Verify with Supplier for exact requirements for compatible mounting base and connects.
 2. All wiring terminated in pull box to have minimum 6 foot lengths for future connections.

2.4 FUEL PIPING

A. Double-Wall Flexible Piping

1. The flexible piping system shall be UL listed, Enviroflex by Total Containment, Geoflex by Environ, or equal.
2. The underground piping system shall consist of flexible double wall pipe or flexible primary pipe contained within a flexible outer containment pipe, each making connection within a series of surface access containment chambers. All piping runs shall be continuous, whereby there shall be no fittings or piping connections, for either the primary or secondary containment pipe which are not visible or accessible from the above ground surface. The secondary containment system shall provide water tight containment of the tank's piping and its associated fittings.
3. All components of the Double Wall piping system shall be compatible with the products to be stored, including Ethanol and Methanol blends.
4. All components of the Double Wall piping system shall be made of non-corrosive materials, or if metallic, such as the fittings and couplings, shall be isolated from corrosion causing elements.
5. The flexible inner primary piping system shall be capable of withstanding liquid pressure five times greater than the designed operating pressures.

B. CONTAINMENT SUMPS

1. All piping terminations and equipment connections shall be made in containment sumps. Sumps shall be made of non-metallic corrosion resistant material.
2. All sumps shall be designed and constructed of materials strong enough for its intended use. Tank and Dispenser Sumps shall not collapse, crack or break due to ground movement, tank movement or from backfill and high ground water pressures. Dispenser Containment Chambers shall not collapse, crack or break due to ground movement or from backfill and high ground water pressures.
3. All sumps shall be fitted with pipe and conduit entry seals which are semi-absorbent to ground movement and sufficiently flexible enough to permit angled entries without leaking under liquid head pressures of up to six feet. No metallic components shall be exposed to the ground.
4. All sumps shall prevent outside surface and ground water from coming in and prevent any leaking product originating within from escaping into the environment.
5. The dispenser sump shall provide a metal framework including concrete secured anchor bolts of such a design that the base frame of the dispenser is mounted directly over the concrete slab. The metal framework shall include one or more fully adjustable stabilizer bars to securely attach a shear valve in such a manner that the valve will properly activate in the event of a dispenser knock-over.

2.5 ACCESSORIES

A. AIR AND WATER HOSE REEL ASSEMBLY

1. Underground cabinet shall:
 - a. Be constructed with heavy duty galvanized steel

- b. Have a stainless steel top assembly with four direction non-snap hose rollers.
 - c. Include an electric resistance heating assembly and supplied with thermostat control. Thermostat shall be mounted in a remote location, as required by Codes.
2. Reels shall be:
- a. Constructed with heavy gauge steel with rolled edges
 - b. Supplied with an automatic spring retractor with locking ratchet mechanism.
 - c. Painted with a high quality electro-static powder coating.
3. Hoses shall be:
- a. 1/4" I.D. and 25 feet long rated at 250 psi
 - b. Provided with a radiator faucet with a heavy duty rubber spout on the water line.
 - c. Provided with a tire inflator gauge with 36" extension hose and two way lock-on chuck.

2.6 OPERATION AND MAINTENANCE MANUAL

- A. The equipment supplier shall provide three copies of all product literature, warranties, operations and maintenance requirements. This information shall be assembled and submitted to the Architect as part of the Operations and Maintenance Manual described in Section 01700, Contract Closeout.

PART 3 - EXECUTION

3.1 TANK INSTALLATION

- A. Tank is to be installed in accordance with the manufacturer's instructions, the drawings, and this specification. Contractor is completely responsible for the installation and he is to be aware of those job conditions which could have an adverse effect and/or require that he advise Owner's Representative for instructions before proceeding. The Contractor is cautioned that this specification and the drawings are for guidance and details, and that the manufacturer's recommendations which accompany each tank take precedence, and must be followed if they differ. Contractor is to accept tanks on the job site and inspect them for damage. Visible damage is to be noted on the delivery receipt and Owner's Representative notified immediately.
- B. Handling - The tank is not to be rolled or dropped. It is to be handled using lifting lugs and guys, and positioned gently.
- C. Testing - Before tanks are placed in position, they shall be put under a 5 lb. air pressure test, or as recommended by the tank manufacturer, in the presence of Owner's Representative.
- D. Piping and Testing - Make piping connections to tank in accordance with the drawings. Test the tank, vapor recovery, and vent lines under 5 psi, soaping all joints, including those around fittings in the tank.

3.2 GASOLINE PIPING

- A. Interior of all piping must be kept free from dirt, scale, metal or fiberglass particles, etc. Contractor will be responsible for damage to pumps or other equipment resulting from foreign materials left in lines. No open pipe ends shall be left unsealed during interruptions in the work.
- B. Piping shall be run as shown on the General Plan at a depth of not less than 18" below surface of driveway. A swing joint or flex connector shall be installed between each submerged pump and its horizontal run of product piping. Swing joint or flex connector shall also be installed beneath each dispenser shear valve.
- C. All product, vapor recovery, and vent lines shall slope to drain back towards tanks without traps.
- D. No gasoline vent riser shall be less than 10 feet measured horizontally from a heater flue or building fresh air inlet or 5 feet measured horizontally from any other building opening. Pipe swings shall be installed on vent piping at the tanks and at the risers.
- E. Pipe swings shall consist of two 90-degree elbows with a 6" long horizontal nipple between elbows. No close nipples shall be used. Flex connectors may be used within sump enclosures.

3.3 FLEXIBLE PIPING INSTALLATION

- A. Double wall flexible pipe shall be UL listed such as Enviroflex, or equal. Installation shall be in accordance with manufacturer's instructions.
- B. Piping trenches shall be dug with a width at twice as wide as the width of all the flexible pipes contained within. Trench turns shall be sweeping with at least a 3 foot inside radius. The bottom of the trench shall include a minimum of 6" of approved bedding material, preferably pea gravel. The bedding and backfill materials should be dry and free from ice, snow and debris. Slope the bedding uniformly at 1/4" per foot fall from the dispenser sump to the turbine sump.
- C. Install the secondary containment pipe between the turbine sumps and dispenser sumps using the pipe manufacturer's sump penetration fittings only.
- D. Backfill the piping trench with approved material. Keep the trench and backfill free from debris and foreign material.
- E. Upon completion of the piping installation, test both the primary and secondary pipe in accordance with the manufacturer's instructions.

3.4 TESTING OF GASOLINE PIPING

- A. All testing shall be performed in conformance with the manufacturer's specifications. A typical procedure is outlined below.
- B. Before backfilling any fiberglass product, vent or vapor return piping for the submerged gasoline pump system is to be tested at a maximum of 50 psi pressure while isolated from tank (by closing

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valve ahead of submerged pump) soaping all joints and fittings. Test completed system with dispenser and pump installed.

- C. Test vent and vapor recovery piping and all connections and openings at tank with not over 5 psi pressure using two gauges calibrated no higher than 10 psi. Any leaks indicated by soap bubbles shall be eliminated by tightening or re-cementing, including those at tank openings.
- D. Notice of Tests and Inspection: All tests shall be made in the presence of Owner's Representative. Contractor must give at least 48 hours notice of any test.

END OF SECTION

SECTION 133419 - METAL BUILDING 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 a rigid-frame-type pre-engineered metal building of the nominal length, width, eave height, and roof pitch indicated. The building system shall include the primary and secondary structural steel system, supporting steel beams for the second-level (mezzanine) floor framing (metal deck and concrete floor system, including stairs and railings, shall be provided by other disciplines), the metal roof system, wall system, and all roof and wall insulation, trim, flashings and accessories as required for a complete building system and as indicated in the specifications and on the drawings. Windows and exterior doors shall be supplied and installed by others. **Secondary framing required for these doors and windows within the metal building structure shall be constructed within the primary structural frame and provided by the metal building manufacturer.**

1. Concrete foundation system for the metal building system shall be engineered and designed by a registered professional engineer licensed in the State of Washington, meeting requirements of the metal building system manufacturer and the requirements indicated on the drawings.
2. The primary structural frame shall consist of welded-up tapered plate section columns and roof beams with necessary splice plates for bolted field assembly. No interior (or mid-span) columns shall be provided for the pre-engineered metal building structure.
 - a. Beam and post end wall frames shall consist of end-wall corner posts, end-wall roof beams and end-wall intermediate posts as required by the design criteria.
 - b. Connection of all major structural members shall be made with A-325 high-tensile bolts through pre-punched or pre-drilled holes for exact alignment.
 - c. All structurals shall be painted with manufacturer's standard primer with manufacturer's standard surface preparation.
 - d. Secondary structurals shall be Z-purlins and girts with red primer finish applied by a coil coater.
 - e. Exterior walls are covered with field-assembled pre-finished metal panel and metal building insulation system, attached to framing members using exposed fasteners through closure strips applied to face of each girt as thermal break.
 - f. Roof system consists of pre-finished metal roof panels over metal building insulation system, attached to framing members using concealed fasteners.
3. Manufacturer's standard building components and accessories shall be provided as required for a complete building system conforming to the design indicated and specified.
4. The metal panel coating system shall be manufacturer's standard silicon polyester coating.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for concrete foundations, walls, slabs and anchor-bolt installation.
2. Division 08 Section "Hollow Metal Doors and Frames."
3. Division 08 Section "Sectional Doors."
4. Division 08 Section "Aluminum Windows."
5. Division 08 Section "Door Hardware" for hardware to the extent not specified in this Section.
6. Division 08 Section "Louvers and Vents" for metal louvers.
7. Division 09 painting Sections for finish painting of shop-primed structural framing.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

- A. General: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with requirements indicated.
1. Provide metal building system of size and with spacings, slopes, and spans indicated on drawings.
- B. Primary Frame Type:
1. (Shop Area) Rigid Clear Span: Solid-member, structural-framing system without interior columns.
 2. (Office Area) Lean To: Solid- or truss-member, structural-framing system without interior columns, designed to be partially supported by another structure.
- C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.
- D. Secondary Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- E. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.
- F. Bay Spacing: As indicated on Drawings.
- G. Roof Slope: 2 inch per 12 inches (1:6).

1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Engineer, design, fabricate and erect the pre-engineered metal building system to withstand loads from winds, gravity, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.
 - 1. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual."
- B. Foundations: Engineer and design concrete foundation system to support the pre-engineered metal building system.
 - 1. Foundation minimum design criteria and standards are indicated on the drawings. The metal building manufacturer shall be responsible for complete design requirements, adhering to all applicable current Codes.
- C. Design Loads: Basic design loads, as well as auxiliary and collateral loads, are indicated on the drawings.
 - 1. Basic design loads include live load, seismic load, and extreme wind load in addition to the dead load.
- D. Structural Framing and Roof and Siding Panels: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual."
 - 1. Structural Steel: Comply with the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses.
 - 2. Light Gage Steel: Comply with the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.
 - 3. Welded Connections: Comply with the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures.

1.6 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following metal building system components:
 - 1. Structural-framing system.
 - 2. Metal roof panels.
 - 3. Metal wall panels and metal soffit panels.
 - 4. Insulation and vapor retarders.
 - 5. Flashing and trim.
 - 6. Accessories.

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- B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
1. Concrete Foundation: Furnish complete foundation design drawings and details prepared by or under the supervision of a professional engineer legally authorized to practice in the State of Washington. Include all requirements indicated on the design/bid drawings. Show anchor bolt settings and required reinforcement.
 2. Structural Framing: Furnish complete erection drawings prepared by or under the supervision of a professional engineer legally authorized to practice in the State of Washington. Include details showing fabrication and assembly of the metal building system. Show anchor bolts settings and sidewall, end-wall, and roof framing. Include transverse cross-sections.
 3. Roofing and Siding Panels: Provide layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include transverse cross-sections.
 4. Building Accessory Components: Provide details of metal building accessory components to clearly indicate methods of installation.
- C. Design Calculations: Suitable for review by approving Engineer and Building Authority.
- D. Samples for initial selection purposes in form of manufacturer's color chips showing full range of actual colors, textures, and patterns available for metal roofing and siding panels with factory-applied finishes. Qualifying manufacturers MUST include the four (4) specific colors listed below in their available color selections:
1. Green color equivalent to Fabral 'Hemlock Green'
 2. Green color equivalent to Fabral 'Patina Green'
 3. Neutral color equivalent to Fabral 'Sandstone'
 4. Neutral color equivalent to Fabral Almond'
- Equivalent colors must be pre-approved during the Bidding process and will be judged as acceptable by the Architect. All colors must be EnergyStar compliant. Selection of up to two colors will be made from the four colors identified, or from any other colors available from the manufacturer's standard color selection, and must be available for either roof or wall panels. Pre-approval shall require the following submittal delivered to the Architect for consideration prior to 14 days before the Bid date:
1. 2 copies of the manufacturer's proposed color selection chart
 2. Substitution Request Form from Section 01 16 00, Product Requirements.
- E. Installer certificates signed by metal building manufacturer written certification certifying that the installer complies with requirements included under the "Quality Assurance" Article.
- F. Professional engineer's certificate prepared and signed by a Professional Engineer, legally authorized to practice in the State of Washington, verifying that the structural framing and covering panels meet the loading requirements and specific deflection limits as indicated on the drawings and meet code requirements of authorities having jurisdiction.
- G. Maintenance Data: For metal panel finishes to include in maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

- A. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- B. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
 - 1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- C. Source Limitations: Obtain primary metal building system components, including structural framing and metal panel assemblies, through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal building system and are based on a specific system used as reference during design. Refer to Division 01 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.9 COORDINATION

- A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate installation of roof penetrations, which are specified in Division 07 Section "Roof Accessories."
- C. Coordinate metal panel assemblies with flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam, metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

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. American Buildings Company.
 - 2. Butler Manufacturing Company.
 - 3. Garco Building Systems.
 - 4. Star Building Systems; Division of Robertson-Ceco Corporation.
 - 5. VP Buildings, Inc.; a United Dominion Company.

2.2 FRAMING MATERIALS

- A. Structural Framing Members: Manufactured from ASTM A529, ASTM A570 or ASTM A572, 50 KSI yield stress. (Light gauge endframes unacceptable).
- B. Secondary Framing Members: Manufactured from ASTM A653, Grade D, structural quality, regular spangle, G-60 galvanized, minimum 17 gauge.
- C. Structural Bolts and Nuts:
 - 1. Primary Framing: Use ASTM A325, minimum 5/8-inch diameter.
 - 2. Secondary Framing: Use SAE grade 5, 1/2-inch diameter.
- D. Wind Bracing Cables and Rods:
 - 1. Cables: ASTM A475, galvanized, 7 strand EHS complete with eyebolts, rod shoes, and hardware as required.
 - 2. Rods: ASTM A36 steel, prime painted, with manufacturer's standard shop primer and hardware, as required.

2.3 FABRICATION, GENERAL

- A. General: Design components and field connections required for erection to permit easy assembly.
 - 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 - 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."
- C. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 - 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.4 STRUCTURAL FRAMING

A. General:

- 1. Primary Framing: Shop fabricate framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - a. Make shop connections by welding or by using high-strength bolts.
 - b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
 - c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - d. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.
- 2. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - a. Make shop connections by welding or by using non-high-strength bolts.
 - b. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary structural members with specified primer after fabrication.
- B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to meet manufacturer's standard, as approved by Architect prior to Bid.
 - 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
- C. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:

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1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch (1.5 mm).
 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch (1.5 mm); or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- D. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise indicated, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- (1.5-mm-) thick steel sheet, built-up steel plates, or structural-steel shapes; minimum 2-1/2-inch- (64-mm-) wide flanges.
 - a. Depth: 8 inches (203 mm).
 2. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- (1.5-mm-) thick steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange and with minimum 2-1/2-inch- (64-mm-) wide flanges.
 - a. Depth: 8 inches (203 mm).
 3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch- (1.5-mm-) thick steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch (51-by-51-by-3-mm) structural-steel angles or 1-inch (25-mm) diameter, cold-formed structural tubing to stiffen primary frame flanges.
 5. Sag Bracing: Minimum 1-by-1-by-1/8-inch (25-by-25-by-3-mm) structural-steel angles.
 6. Base or Sill Channels: Minimum 3-by-2-by-0.0598-inch (76-by-51-by-1.5-mm) zinc-coated (galvanized) steel sheet.
 7. Purlin and Girt Clips: Minimum 0.0598-inch- (1.5-mm-) thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598-inch- (1.5-mm-) thick, zinc-coated (galvanized) steel sheet.
 9. Framing for Openings: Channel shapes; fabricated from minimum 0.0598-inch- (1.5-mm-) thick, cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
 10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- E. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads, fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.
1. Type: Purlin-extension type.
- F. Bracing: Provide adjustable wind bracing as follows:

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1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 (345); or ASTM A 529/A 529M, Grade 50 (345); minimum 1/2-inch- (13-mm-) diameter steel; threaded full length or threaded a minimum of 6 inches (152 mm) at each end.
 2. Cable: ASTM A 475, 1/4-inch- (6-mm-) diameter, extra-high-strength grade, Class B zinc-coated, 7-strand steel; with threaded end anchors.
 3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 4. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 5. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 6. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
- G. Bolts: Provide plain finish bolts for structural-framing components that are primed or finish painted. Provide hot-dipped galvanized bolts for structural-framing components that are galvanized.
- H. Factory-Primed Finish: Apply specified primer immediately after cleaning and pretreating.
1. Prime primary, secondary, and end-wall structural-framing members to a minimum dry film thickness of 1 mil (0.025 mm).
 2. Prime galvanized members with specified primer, after phosphoric acid pretreatment.

2.5 ROOF PANELS

- A. Panel: High profile mechanical seamed 3-inch tall Standing Seam with three pronounced stiffening ribs per panel.
1. Material: Minimum 24-gauge Galvalume/Zincalume conforming to ASTM A724/A792 for coating AZ50.
 2. Panel Coverage: 24-inches.
 3. Finish Coating: Polyvinylidene Fluoride with Kynar 500 finish
 - a. Color: As selected by Architect from manufacturer's full line of colors.
 - b. Refer to paragraph 1.6 D., above for color selection requirements
 4. Attachment: Concealed two-piece clip, allowing thermal movement.
 5. Uplift Rating: UL90.
 6. Basis of Design: *Fabral, Seam Rib 324* panel, or pre-approved equivalent.

2.6 METAL SOFFIT PANELS

- A. Panel: Concealed-Fastener Metal Soffit Panels formed with vertical panel edges with flush joint between panels; designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.
1. Material: Minimum 24-gauge Galvalume/Zincalume conforming to ASTM A724/A792 for coating AZ50.
 2. Panel Coverage: 12-inches.
 3. Panel Height: 1.5 inches.

4. Finish Coating: Polyvinylidene Fluoride with Kynar 500 finish
 - a. Color: As selected by Architect from manufacturer's full line of colors.
 - b. Refer to paragraph 1.6 D., above for color selection requirements
5. Attachment: Concealed two-piece clip, allowing thermal movement.
6. Basis of Design: *Fabral, Select Series 12-R2* panel, or pre-approved equivalent.

2.7 WALL PANELS

- A. Panel: "RW" Type with full bearing leading edge rib, 1-1/2-inch trapezoidal rib and two stiffener ribs spaced 12 inches on center.
 1. Material: Minimum 24 gauge, Galvalume/Zincalume conforming to ASTM A792 for coating AZ50.
 2. Panel Coverage: 36 inches.
 3. Finish Coating: Polyvinylidene Fluoride with Kynar 500 finish
 - a. Color: As selected by Architect from manufacturer's full line of colors.
 - b. Refer to paragraph 1.6 D., above for color selection requirements
 4. Attachment: Self-drilling, self-tapping, HWH screws with sealing washers through flat of panel.
 5. Basis of Design: *Fabral, Ultra-Rib* panel, or pre-approved equivalent.

2.8 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS

- A. Basis-of-Design Product: The design for Metal Building Insulation is based on **Simple-Saver System, by Thermal Design, Inc. (800)255-0776**. Subject to compliance with requirements, provide the named product or a comparable product with prior approval.
 1. Insulation Material: Shall be fiberglass blanket or batt insulation meeting Federal Specifications HH-1 588B, Form B, Type 1 or other insulation form as may be recommended and submitted by the system manufacturer and approved by the architect during submittals.
 2. Insulation Value (Roof): R-38, 8" + 4" double-layer system.
 3. Insulation Value (Walls): R-25, 8" single-layer system.
 4. Thermal Break: A thermal break shall be applied between metal panel and metal structure. The thermal break shall be 1/8" x 3" foam tape.
- B. Accessories and Components:
 1. Insulation Material: Shall be fiberglass blanket or batt insulation meeting Federal Specifications HH-1 588B, Form B, Type 1 or other insulation form as may be recommended and submitted by the system manufacturer and approved by the architect during submittals.
 2. Syseal™ Fabric: Shall be woven reinforced high-density polyethylene yarns coated on both sides with a continuous white or colored polyethylene film. The fabric shall be UL or ULC listed, Class A compliant with a low flame spread index of 25 or less and smoke density index of 50 or less based on ASTM E-84 test standards.
 - a. Fabric color (walls and Ceiling): UVMAX™ White.
 3. Installation Hardware: Steel Straps, Fasteners and Sealants as recommended by product manufacturer.

- C. Thermal Break: A thermal break shall be applied between metal panel and metal structure. The thermal break shall be 1/8" x 3" foam tape.

2.9 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, formed from steel sheet, designed to withstand negative-load requirements.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where necessary to ensure weathertight construction and to discourage insect access to back-panel areas.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Penetration Closures: Where light fixtures, receptacles, piping, conduit or any other component penetrates or mounts to the metal panel, provide a blank-panel escutcheon to raise penetrating/mounting surface to the highest level of the panel profile. Escutcheons may be fabricated from a variety of materials, depending on use, but must match or coordinate with the wall panel color and provide adequate support or backing for mounting of fixtures. Maintain adequate size for escutcheon to accommodate penetrating component but do not oversize. Provide all required support and finish.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction and to discourage insect access to back-panel areas.
- D. Flashing and Trim: Formed from minimum 0.0159-inch- (0.40-mm-) thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.

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1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Minimum 0.0269-inch- (0.70-mm-) thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Formed from minimum 0.0478-inch- (18 gauge) thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2438-mm-) long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters; spaced 48 inches (900 mm) o.c.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Formed from minimum 0.0239-inch- (24 gauge) thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- (3-m-) long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters; spaced 10 feet o.c.
- G. Snow Guards: Roofing manufacturer's standard prefabricated, non-corrosive units designed to be installed without penetrating roof panel, with predrilled holes and clamps or hooks for anchoring.
1. Metal-Type Guard: Consisting of aluminum or stainless-steel rods or bars held in place by supports clamped to vertical ribs of standing-seam roof.

2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive

structural framing, with Erector present, for compliance with requirements and metal building system manufacturer's tolerances.

- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- F. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.
 - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - a. Joint Type: Snug tightened or pretensioned.

- G. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.
 - 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 - 1. Tighten rod and cable bracing to avoid sag.
 - 2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Examination: Examine primary and secondary framing to verify that structural panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 - 1. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal panel installation.
- B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes. Field cutting of metal panels by torch is not permitted.
 - 2. Install metal panels perpendicular to structural supports, unless otherwise indicated.
 - 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- C. Lap-Seam Metal Panels: Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or metal panels. Install screws in predrilled holes.
 - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

- D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations.
 1. Install ridge caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
 1. Install clips to supports with self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Provide metal closures at rake edges, rake walls and each side of ridge caps.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 2. Shim or otherwise plumb substrates receiving metal wall panels.
 3. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 4. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
 5. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 6. Install screw fasteners in predrilled holes.
 7. Install flashing and trim as metal wall panel work proceeds.

8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated, or if not indicated, as necessary for waterproofing.
9. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws.
10. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Field-Assembled, Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

1. Field-Insulated Assemblies: Install thermal insulation as specified. Install metal liner panels over insulation on interior side of girts at locations indicated. Fasten with exposed fasteners as recommended by manufacturer.

3.7 METAL SOFFIT PANEL INSTALLATION

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

3.8 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL PANELS

- A. General: Install insulation concurrently with metal wall panel installation, in thickness indicated to cover entire wall, according to manufacturer's written instructions.
 1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 3. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation with both sets of facing tabs sealed to provide a complete vapor retarder.

3.9 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

DIVISION 13 - SPECIAL CONSTRUCTION

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet (1.2 m) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
1. Tie downspouts to underground drainage system indicated.
- E. Louvers: Coordinate louver locations with Mechanical drawings. Provide openings for louvers to be installed by another trade.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.10 FIELD QUALITY CONTROL

- A. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports.
- B. Tests and Inspections:
1. High-Strength, Field-Bolted Connections: Connections shall be inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:
 - a. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - b. Ultrasonic Inspection: ASTM E 164.
 - c. Radiographic Inspection: ASTM E 94.
- C. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

3.11 CLEANING AND PROTECTION

- A. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

- B. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 133419

SECTION 220500 – GENERAL REQUIREMENTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK – GENERAL

- A. This section specifies general requirements for plumbing installations and includes requirements common to more than one section of Division 22. It expands and supplements the requirements specified in sections of Division 01.
- B. Provide materials, labor, transportation, tools, permits, fees, inspections, utilities and incidentals necessary for the complete installation of plumbing work indicated and described in the Contract Documents.
- C. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified under this section of work or work specified in other sections, provide material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned or not.

1.3 SEQUENCE OF WORK

- A. Conduct work in sequence to provide least possible interference to the activities of the Owner, and to permit orderly transfer of activities and equipment to completed areas.
- B. Work shall be substantially complete by the dates listed in Division 01 Section “Summary”.

1.4 ALTERNATES

- A. Refer to Division 01 Section “Alternates” for description of alternates. Review Contract Documents for additional information.

1.5 DEFINITIONS

- A. Provide: Furnish and install complete and ready for intended use.
- B. Indicated: Indicated on drawings.
- C. Noted: Noted on Drawings or in Specifications.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

- E. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- F. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- H. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.6 CODES AND STANDARDS

- A. Code Compliance: Comply with most current adopted edition of following:
 1. International Building Code (IBC), Standards and Amendments.
 2. International Mechanical Code (IMC), Standards and Amendments.
 3. International Fire Code (IFC), Standards and Amendments.
 4. Uniform Plumbing Code (UPC), Standards and Amendments.
 5. International Fuel Gas Code (IFGC).
 6. National Fire Protection Association (NFPA).
 7. National Electrical Code (NEC); NFPA 70.
 8. Applicable State and local codes, laws and ordinances.

1.7 SAFETY OF PERSONS AND PROPERTY

- A. Comply with applicable laws, ordinances, rules and regulations of any public authority for the safety of persons and property, including requirements of the Washington Industrial Safety and Health Administration (WISHA) and/or the Occupational Safety and Health Act (OSHA) and Division 01, General and Supplementary Conditions.

1.8 PERMITS AND FEES

- A. Obtain and pay for required permits and fees necessary to fully complete work included in the Contract Documents.

1.9 INTENT AND INTERPRETATION

- A. Drawings and Specifications supplement each other and any details contained in one and not the other shall be included as if contained in both. Items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation shall be included.
- B. Drawings are partly diagrammatic and do not necessarily show exact location of new piping and existing utilities, unless specifically dimensioned.
- C. Riser and other diagrams are schematic only and do not necessarily show the physical arrangement of equipment. They shall not be used for obtaining quantities or lineal runs of piping.

- D. Fixtures or other pieces of equipment shall be centered on windows, wall spaces, or other items, unless specifically dimensioned otherwise.
- E. Location of piping shall be checked to determine that it clears openings and structural members; that it may be properly concealed; and that it clears cabinets, lights and equipment having fixed locations.
- F. Mechanical drawings shall serve as working drawings for Division 22 work. Refer to Architectural, Structural, Civil, Landscape and Electrical drawings for additional detail affecting the installation of work. Architectural drawings shall take precedence over the Mechanical drawings if any dimensional discrepancies exist.
- G. Approximate location of each item is indicated on the drawings. These drawings are not intended to give complete and exact details in regard to location. Exact locations are to be determined by actual measurements at the building. Not all pipe and duct offsets are indicated on the drawings.

1.10 SUBMITTAL OF EQUIPMENT FOR APPROVAL

- A. Refer to Division 01 requirements for submittal definitions, requirements and procedures. Additional requirements are listed below.
- B. Shop drawings, catalog information, and material schedules shall be submitted for approval on materials and equipment prior to ordering.
- C. Submittals not meeting the following requirements will be returned for revision:
 - 1. Provide a cover page for each item or group of items (schedule group, single fixture plus trim group, etc.). Cover page shall provide a 3" x 5" space for Engineer's review stamp
 - 2. Each cover page must be clearly identified with the project name, specification number and paragraph number.
 - 3. Submittal package must be accompanied by an itemized index listing specification section, paragraph number, item and manufacturer; larger projects will be index tabbed by specification section with index for each section.

1.11 SCHEDULE OF VALUES

- A. Furnish to the Engineer, a breakdown of the Contract for work in Division 22 within 30 days of Notice to Proceed.
- B. The breakdown shall list cost for materials and labor as follows:
 - 1. Miscellaneous Overhead Expenses
 - 2. Plumbing Rough-in:
 - a. Underground Piping
 - b. Aboveground Piping
 - c. Pipe Insulation
 - 3. Plumbing Finish:
 - a. Fixtures
 - b. Plumbing Equipment
 - c. Final Connection
 - 4. Testing, Adjusting and Balancing

5. Commissioning Support
6. Project Closeout:
 - a. O & M Manuals
 - b. Record Documents

1.12 GUARANTEE

- A. Guarantee satisfactory operation of material and equipment installed under Division 22. Repair or replace any defective materials, equipment, or workmanship which may show itself within one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Where more than one manufacturer is listed, provide products of only one manufacturer for each type of product.
- B. Materials used under this Contract, unless specifically noted otherwise, shall be new and of the latest and most current model line produced by the manufacturer. Outdated "new" equipment is not acceptable.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Fuel-fired equipment shall be listed by a nationally recognized testing agency.
- E. Furnish pressure vessels and relief valves in accordance with applicable Boiler and Unfired Pressure Vessel Laws.

2.2 EQUIPMENT AND MATERIAL SUBSTITUTIONS

- A. Throughout these Contract Documents, various materials, equipment, apparatus, etc., are specified by manufacturer, brand name, type or catalog number. Such designation is to establish standards of desired quality and construction and shall be the basis of the bid.
- B. Where more than one manufacturer is listed, and only one manufacturer's catalog number is indicated, that standard of quality and construction shall be maintained by materials supplied by other manufacturer(s).
- C. Substitutions of equipment or materials shall be made only with written prior approval. Prior approval requests must be received at least ten (10) days prior to bid date unless otherwise instructed. Refer to Division 01 Section "Substitution Procedures" for procedures in requesting substitutions. The Owner or Owner's representative shall review all substitution requests for final approval.
- D. Substitution request must include manufacturer, specific model number, special features, physical dimensions, and capacities of proposed equipment. Verify requirements before submitting for approval.

- E. The Contractor shall bear full responsibility for substituted equipment and materials, including, but not limited to:
 - 1. Costs.
 - 2. Available space requirements
 - 3. Effect on other trades
 - 4. Changes in electrical requirements
 - 5. Changes in structural requirements.

PART 3 - EXECUTION

3.1 SUSTAINABILITY

- A. Comply with requirements of Division 01 Section, "Sustainable Design Requirements".

3.2 COMMISSIONING

- A. Comply with requirements of Division 01 Section "General Commissioning Requirements" and requirements of individual Division 22 Sections for Plumbing Commissioning.

3.3 COORDINATION

- A. Refer to Division 01 Section "Project Management And Coordination".
- B. Coordinate available space for equipment and systems with other trades. Refer to Architectural, Structural and Electrical Drawings for additional building details necessary for coordination.
- C. Cutting, patching, wiring, finishing or any other work required for relocation of work installed due to interferences between work of the various trades will be at no additional cost to the Owner.

3.4 MANUFACTURER'S INSTRUCTIONS

- A. Furnish proper equipment and/or materials required for installation as intended by the manufacturer, for all work described under Division 22. If needed for proper installation or operation, request advice and supervisory assistance from the representative of the specific manufacturer. Manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufactured materials or equipment, unless otherwise indicated. Promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's instructions before proceeding with the work.

3.5 SITE UTILITY SERVICES

- A. Where applicable, make connections to existing permanent cold water service immediately so as to provide the use of this service by other trades. Comply with Division 01 requirements.

3.6 LAYING OUT WORK

- A. Locations of equipment and devices, as shown on the drawings, are approximate unless dimensioned. Exact locations of such items shall be determined from the Construction Drawings. Verify physical dimensions of each item of mechanical equipment, ductwork system and piping system, to fit available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordinate equipment to available space and access routes through construction. Offsets or transitions in ductwork or piping systems required for proper system operation and/or installation, whether indicated on drawings or not, shall be provided at no additional cost to Owner.

3.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- C. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

3.8 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate location of concealed equipment and devices requiring access with location of access panels and doors. Allow ample space for removal of parts that require replacement or servicing.

3.9 TEMPORARY USE OF NEW EQUIPMENT

- A. New equipment shall not be used for temporary plumbing unless authorized in writing by the Owner.

END OF SECTION 220500

SECTION 220505 – PROJECT CLOSEOUT FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 01 Section “Closeout Procedures”.

1.2 SCOPE OF WORK - GENERAL

- A. This section specifies procedural requirements for plumbing installations project closeout, including but not limited to:
 - 1. Project Record Document submittal.
 - 2. Operation and Maintenance Manual submittal.
 - 3. Operation and Maintenance Instruction and Training.
 - 4. Mechanical Equipment and Systems Start-Up.
 - 5. Lubrication.
 - 6. Final Cleaning.

1.3 PROJECT RECORD DOCUMENTS

- A. Record differences between mechanical work as installed and as shown in Contract Drawings on a set of prints of mechanical drawings furnished by Architect. Return these prints to Architect at completion of project. Notations made on drawings shall be neat and legible. Comply with Division 01 Section requirements.
- B. Mark drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers, and other control devices, filters, motors and similar items requiring periodic maintenance; actual equipment locations; concealed equipment and control devices; mains and branches of piping systems, with valves and control devices located and numbered; actual inverts and locations of underground piping.
- C. Revise equipment and fixture schedules on the Drawings to indicate actual installed manufacturer and model numbers.
- D. Mark specifications to indicate change orders; actual equipment and materials used.
- E. The Commissioning Authority may review record drawings once monthly for completeness.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Prepare and submit Operation and Maintenance (O&M) Manuals for mechanical systems provided. Comply with Division 01 Section requirements.

B. Manual binder shall have permanent lettering of a contrasting color. Information to be included on the binder is as follows:

1. The front cover shall be lettered as follows:

PLUMBING
OPERATION AND MAINTENANCE

MANUAL

(PROJECT NAME)

(CITY AND STATE)

(YEAR)

OWNER:

(NAME)

ARCHITECT:

(NAME

MECHANICAL ENGINEER:

L&S ENGINEERING ASSOCIATES, INC.

GENERAL CONTRACTOR:

(NAME)

MECHANICAL CONTRACTOR:

(NAME)

2. The spine shall be lettered as follows:

PLUMBING O & M MANUAL (Year)
(Project Name)

C. Provide master index at beginning of Manual showing sections and items included. Use plastic tab indexes for sections of Manual.

D. Cover section: List name, address, and phone number of Project Architect, General Contractor, Mechanical Engineer, Mechanical Contractor and all Mechanical Sub-Contractors. Provide a list of equipment suppliers with address and phone number.

E. Provide a separate section for each Section of the Specifications. Provide index for each section listing equipment included. Include all items specified.

F. Include descriptive literature (manufacturer's catalog data) of each manufactured item. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined. Data sheets shall be originals or clean copies of originals. Copies of faxes are not acceptable. Include copies of approved submittals or shop drawings for all items requiring submittal.

- G. One draft copy of the manual shall be submitted to both the Engineer and Commissioning Authority for review, comment and approval, as applicable, at least 15 days prior to substantial completion or training, whichever is first. After approval, submit 3 copies of manual to Architect for approval unless otherwise directed by Division 01 Section requirements. Information to be included in manual:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping shut-down, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
 5. Schematic control diagrams for each automatic control system. Mark correct operating setting for each control instrument on these diagrams.
 6. Valve schedule indicating the valve symbol (tag number), valve location by room number and description, valve purpose and system served, and valve size. Provide 1 corresponding set of full size mechanical prints showing these valve locations for cross-reference. A second complete set of valve schedules (8 1/2 in. x 11 in.) encased in clear plastic laminate and fitted in an aluminum holding frame shall be furnished to the Owner.
 7. Test records and certifications.
 8. Equipment start-up reports.
 9. Warranty information and letters of guarantee.
 10. Instruction period checklist for each equipment item.
- H. Complete O&M Manual shall be available for use by Owner's representatives during instruction and training sessions.

1.5 OPERATION AND MAINTENANCE INSTRUCTION AND TRAINING

- A. Instruct Owner's Representative(s) in the Operation and Maintenance procedures described in Operation and Maintenance Manual. Comply with Division 01 Section requirements.
- B. Enlist services of qualified personnel, including each sub-trade and factory trained specialists for each major piece of equipment, to attend training sessions and provide operation and maintenance instructions.
- C. The Commissioning Authority is responsible for preparing the final list of equipment requiring training for the Owner's personnel. Additional training sessions may be required by the owner based on staffing requirements at the campus. Training sessions shall be scheduled with the Commissioning Authority at least two weeks in advance. Prior to scheduling, the contractor must submit a lesson plan to the Commissioning Authority with topics to be covered during training, a list of persons recommended to attend, and any documents or other audio visual aids that will be used in the training sessions.
- D. Sign in sheets shall be used for all attendees, including manufacturer's, vendor's and contractor's personnel. Obtain written sign off on all training sessions from the Commissioning Authority and Owner.

- E. Allow a minimum of four hours instructional time per equipment category. Refer to individual Division 22 sections for additional instruction/training requirements.”
- F. Training sessions on key pieces of equipment or systems may be required by the Owner to be video recorded. Any such recordings should be produced on DVD or VHS video format. Coordinate requirements with the Commissioning Authority.
- G. All mechanical systems shall be properly functioning prior to instruction period.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 MECHANICAL EQUIPMENT AND SYSTEMS START-UP

- A. Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service and demonstrate and train Owner's maintenance personnel.
- B. Include certification of factory-authorized representative status as part of equipment submittal from manufacturer. Include copies of any installation and start-up instructions, manufacturer's checklists and other forms used in start-up as part of the equipment submittal. These instructions and checklists will be utilized by the Commissioning Authority in developing start-up and functional performance testing procedures in accordance with Division 01 Section "General Commissioning Requirements", and Division 22 Section "Commissioning of Plumbing". Upon successful completion of equipment start-up, a copy of all manufacturer's forms will be given to the Commissioning Authority for enclosure in the records.
- C. Include written start-up reports with test data for equipment in Operation and Maintenance Manual.
- D. All construction debris, including electrical wiring debris shall be removed from units prior to equipment start up. Areas surrounding and served by equipment being started must be free of construction debris, sheetrock dust and any materials that may adversely affect the equipment.

3.2 LUBRICATION

- A. Lubricate all pieces of equipment in accordance with Manufacturer's written instructions prior to project closeout. Include a listing of all equipment with the date of final lubrication in Operation and Maintenance manual.

3.3 FINAL CLEANING

- A. Refer to Division 01 general requirements for final cleaning.
- B. At time of final cleanup, clean all fixtures and equipment and leave in condition for use intended. Vacuum cabinet interiors of control panels, air handling units, etc. to remove all construction debris including electrical wiring debris.

3.4 COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Division 01 Section "Commissioning General Requirements" and Division 22 Section "Commissioning of Plumbing". The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 220505

SECTION 220509 – COMMON MATERIALS AND METHODS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to plumbing systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting.
 - 10. Supports and anchorages.
 - 11. Access doors.
 - 12. Through-penetration fire stop systems.
 - 13. Excavation and backfill.
 - 14. Cutting and patching.

1.3 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.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- 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. PVC: Polyvinyl chloride plastic.

3. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
 5. Access Doors.
 6. Through-Penetration Fire Stop Systems.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical 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 mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers listed.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BAg1, 15% silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 1. ABS Piping: ASTM D 2235.
 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 3. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epcos Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epcos Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: 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.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 22 gage 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. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 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, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

- F. Split-Plate, Stamped-Steel Type: With 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.

2.9 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.

2.10 ACCESS DOORS

- A. Description: Access doors, non-rated and fire-rated for ceiling and wall surfaces.
- B. Manufacturers:
 - 1. Acudor Products, Inc.
 - 2. Cesco Products.
 - 3. Elmdor/Stoneman; Div. Of Acorn Engineering Co.
 - 4. Karp Associates.
 - 5. Milcor .
- C. Flush, Insulated, Fire-Rated Access Doors and Trimless Frames: Fabricated from steel sheet.
 - 1. Locations: Gypsum board wall and ceiling surfaces.
 - 2. Fire-Resistance Rating: One and a half hours, "B" label.
 - 3. Temperature Rise Rating; 250 degrees at the end of 30 minutes.
 - 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
 - 5. Frame: Minimum 0.060 inch thick sheet metal with drywall bead.
 - 6. Hinges: Continuous piano hinge.
 - 7. Automatic Closer: Spring type.
 - 8. Latch: Self-latching bolt with interior release.
- D. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
 - 1. Locations: Gypsum board wall and ceiling surfaces.
 - 2. Door: Minimum 0.060 inch thick sheet metal, set flush with exposed face flange of frames.
 - 3. Frame: Minimum 0.060 inch thick sheet metal with 1 inch wide surface-mounted trim.
 - 4. Hinges: Continuous piano hinge.
 - 5. Latch: Screwdriver operated cam latch.
- E. Flush Access Doors and Trimless Frames: Fabricated from steel sheet.
 - 1. Locations: Gypsum board wall and ceiling surfaces.
 - 2. Door: Minimum 0.060 inch thick sheet metal, set flush with surrounding finish surfaces.
 - 3. Frame: Minimum 0.060 inch thick sheet metal with drywall bead.
 - 4. Hinges: Continuous piano hinge.

5. Latch: Screwdriver operated cam latch.

2.11 THROUGH-PENETRATION FIRE STOP SYSTEMS

- A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
 1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
 2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
 3. Fire-resistance-rated floor assemblies.
 4. Fire-resistance-rated roof assemblies.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
Penetrations located outside wall cavities.
 1. Penetrations located outside fire-resistive shaft enclosures.
 2. Penetrations located in construction containing fire-protection-rated openings.
 3. Penetrating items larger than 4-inch diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
- D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
- E. Related sections include the following:
 1. Division 07 Section "Firestopping".
 2. Division 22 Sections specifying duct and piping penetrations.
- F. Submittals:
 1. Product Data: For each type of through-penetration firestop system product indicated.
 2. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
 3. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
- G. Manufacturers:
 1. Bio-Fireshield
 2. Firestop Systems Inc.
 3. Hilti Construction Chemicals, Inc.
 4. International Protective Coatings Corp.

- 5. RectorSeal Corporation .
- 6. 3M Fire Protection Products.

2.12 EXCAVATION AND BACKFILL

- A. Bedding and initial backfill material: Clean, sand-gravel mixture free from organic matter and conforming to the following gradation when tested in accordance with ASTM D 2940.

U.S.	Percent Passing
Standard	Sieve Size
1 inch	100
No. 200	0-10

- B. Backfill: Satisfactory soil materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP, free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved.
- 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. Do not run piping directly over electrical panels or switchgear.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.

- K. Install piping to allow application of insulation.
- L. Cap or seal temporary openings in piping during construction. Remove caps or seals for final connections.
- M. Select system components with pressure rating equal to or greater than system operating pressure.
- N. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
- O. Sleeves are not required for core-drilled holes.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions where specifically indicated and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. 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.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

- 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. 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.
- T. Fire-Barrier Penetrations:
 - 1. Use metallic piping only for fire-barrier penetrations. Transition from system pipe material to penetration material as required.
 - 2. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- U. Verify final equipment locations for roughing-in.
- V. 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 AWS A5.8, BAg1, 15% silver alloy brazing filler metal.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 4. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each threaded valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical 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. Painting of mechanical systems, equipment, and components is specified in Division 09 Section "Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

- A. Mix and install grout for mechanical 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.

3.8 ACCESS DOORS

- A. Provide access doors wherever required to service valves, dampers, fire dampers, motor or any other items of equipment where concealed, unless specifically indicated on the drawings to be furnished under other Section(s).
- B. Size and locate access doors for service and maintenance of equipment items to allow adequate access for required service.
- C. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.
- D. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- E. Adjust doors and hardware after installation for proper operation.
- F. Label access doors.

3.9 THROUGH-PENETRATION FIRESTOP SYSTEMS

A. Examination:

1. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Preparation:

1. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer:
2. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Through-Penetration Firestop System Installation:

1. General: Install through-penetration firestop systems in accordance with manufacturer's written installation instructions and published drawings for products and applications indicated.
2. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

D. Cleaning and Protection:

1. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
2. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

3.10 EXCAVATION AND BACKFILL

- A. Provide necessary excavation, shoring, and backfilling required for proper installation of mechanical work.
- B. During excavation, stockpile material satisfactory for backfilling in an orderly manner at a distance from the banks of the trench equal to half the depth of the excavation, but in no instance closer than 2 feet. Remove excavated material not required or not satisfactory for backfill from the site and dispose of properly. Grading shall be done as necessary to prevent surface water from flowing into the excavation. Remove accumulated water to maintain stability of the bottom and sides of excavation.

- C. Excavate trenches to depth required to establish indicated slope and invert elevations and to support bottom of piping or conduit on undisturbed soil. Trenches shall be of uniform width, sufficient to provide ample working room and a minimum of 12 inches of clearance on both sides of pipe or conduit.
- D. Grade bottoms of trenches to provide uniform bearing and support for bottom quadrant of each section of pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing.
- E. Remove stones of 2 inches or greater in any dimension, or as recommended by pipe manufacturer, whichever is smaller, to avoid point bearing. Where unyielding material is encountered in the bottom of trench, remove such material 6 inches below required grade and replaced with materials described below for bedding.
- F. Place bedding and initial backfill material to a depth of 6 inches over the top of piping. Bring material up evenly on both sides of pipe for full length of pipe.
- G. Backfill to the required grade in layers not exceeding 4 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines otherwise specified. Compact top 12 inches below subgrade and each layer of backfill at 95 percent maximum dry density (ASTM D 1557) under structures, building slabs, steps, pavements and walkways. Compact the top 6 inches below subgrade and each layer of backfill at 90 percent maximum dry density (ASTM D 1557) under lawn or unpaved areas.
- H. Do not cover underground lines until installation has been approved by the inspector having jurisdiction and Owner's Representative.
- I. Cut trenches within 5 feet of footings or under footings only after approval of the Architect.
- J. Provide bracing and shoring where depth of excavation or character of ground render it necessary for personnel protection. Comply with local and state safety laws and regulations.
- K. Remove bracing and shoring materials before backfilling except where necessary to insure against caving.
- L. Provide securely constructed barricades around excavation.
- M. Exercise extreme care while excavating in the area of utilities, carefully check for location of possible utilities, whether shown on the drawings or not, and establish location of cutoff valves for ready shut-off of service in case of emergency. Assume complete responsibility for all damage to any utilities caused in excavating as well as damage to personnel and property caused by said damaged utilities whether shown on drawings or not.

3.11 CUTTING AND PATCHING

- A. Comply with Division 01 Section, "Execution" for general requirements for cutting and patching.

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- B. Cutting shall be performed with masonry saws, core drills or similar equipment to provide neat and uniform openings.
- C. Patching shall match adjacent surfaces in materials and finish. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations. will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work.
 - 2. Remove and replace defective work.
 - 3. Remove and replace work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed work as specified for testing.
 - 5. Install equipment and materials in existing structures.
 - 6. Upon written instructions from the Architect, uncover and restore work to provide for observation of concealed work.
- G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by new work.
- H. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- I. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.12 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 220509

SECTION 220511 – ELECTRICAL PROVISIONS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 22 Section “Common Motor Requirements for Plumbing Equipment”.

1.2 SUMMARY

- A. This section specifies basic requirements for field-installed accessory electrical components specified as a part of packaged mechanical equipment. These components include, but are not limited to controllers, motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment, but not factory-installed.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are specified within the individual equipment specifications or scheduled on the drawings.
- C. Make all required electrical connections from mechanical equipment to accessory electrical components furnished by manufacturer as a part of equipment but intended to be field-installed, including pushbuttons, pilot lights, interlocks, speed controllers, and similar devices.
- D. Provide all required electrical connections of field-mounted float control switches, flow control switches, and similar mechanical/electrical devices provided for pumps and similar mechanical equipment.
- E. Provide interconnecting wiring between mechanical equipment shipped in multiple parts and designed by the manufacturer to have field-installed interconnecting wiring.
- F. All electrical work shall comply with applicable requirements of Division 26.

1.3 REFERENCES

- A. NEMA Standard ICS 2: Industrial Control Devices, Controllers and Assemblies.
- B. NEMA Standard 250: Enclosures for Electrical Equipment.
- C. NEMA Standard KS 1: Enclosed Switches. Comply with National Electrical Code (NFPA 70).

1.4 SUBMITTALS

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves as required by the individual equipment specification sections.

1.5 QUALITY ASSURANCE

- A. All electrical components and materials shall be labeled by an approved testing agency (UL, ETL, CSA, etc.).

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with applicable requirements of Division 26 and NFPA 70 (National Electrical Code).
- B. Install equipment and wiring per manufacturer's instructions.

3.2 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 220511

SECTION 220519 – METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following meters and gages for plumbing piping:
 - 1. Thermometers.
 - 2. Gages.
 - 3. Test plugs.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. Marsh Bellofram.
 - 2. MILJOCO Corporation.
 - 3. Tel-Tru.
 - 4. Trerice, H. O. Co.
 - 5. Weiss Instruments, Inc.
 - 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 7. Winters Instruments.
- B. Case: Plastic or die-cast aluminum, 9 inches long.
- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Metal, for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
 - 1. Material: Brass, for use in copper piping.
 - 2. Material: Steel, for use in steel piping.
 - 3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
 - 4. Insertion Length: To extend to center of pipe, minimum insertion length 2-1/2 inches.

2.4 PRESSURE GAGES

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 3. Marsh Bellofram.
 - 4. MILJOCO Corporation.
 - 5. Tel-Tru.
 - 6. Terice, H. O. Co.
 - 7. Weiss Instruments, Inc.
 - 8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 9. WIKA Instrument Corporation.
 - 10. Winters Instruments.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Dry type, cast aluminum, 4-1/2-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red or other dark-color metal.
 - 7. Window: Glass.
 - 8. Ring: Stainless steel.
 - 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

A. Manufacturers:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. Peterson Equipment Co., Inc.
4. Sisco Manufacturing Co.
5. Trerice, H. O. Co.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: Two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be chlorosulfonated synthetic rubber.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:

1. Outlet of each water heater.
2. Where indicated on Drawings.

B. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Building water-service entrance.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending a minimum of 2 inches into fluid or to center of pipe and in vertical position in piping tees where thermometers are indicated.

C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

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- D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.
- E. Provide test plugs at the following locations whether indicated on plans or not:
 - 1. Adjacent to all gauges, temperature or pressure sensors, and thermometers. If instruments/ sensors are grouped, one test plug will suffice if provided in a common location.
 - 2. Adjacent to the supply and discharge of all pumps and manual flow control devices.
 - 3. Adjacent to each temperature control sensor thermowell.
- F. Restricting devices (pressure reducing valves, etc.) shall not be placed between test plugs and device being tested.
- G. Install flow indicators, in accessible positions for easy viewing, in piping systems.

3.4 CONNECTIONS

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

3.5 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 220519

SECTION 220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following general-duty valves for plumbing piping:
 - 1. Ball valves.
 - 2. Butterfly valves.
 - 3. Swing check valves.
 - 4. Spring-loaded, lift-disc check valves.
 - 5. Gate valves.
- B. Related Sections include the following:
 - 1. Division 22 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. WOG: Non-shock Water-Oil-Gas working pressure rating, psig.
 - 2. SWP: Steam working pressure rating, psig.
 - 3. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 4. PTFE: Polytetrafluoroethylene plastic.
 - 5. TFE: Tetrafluoroethylene plastic.
 - 6. NRS: Non-rising stem.
 - 7. RS: Rising stem.
 - 8. OS&Y: Outside stem and yoke.
 - 9. MSS: Manufacturer's Standardization Society of the Valve and Fittings Industry.
 - 10. PPS: Polyphenylene sulfide.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances.
- B. Maintenance Data: For each type of valve indicated to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10.
- C. ASME Compliance for Bronze Valves: ASME B16.24.

D. MSS Compliance:

1. SP-67: Butterfly Valves.
2. SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends.
3. SP-71: Gray Iron Swing Check Valves, Flanged and Threaded Ends.
4. SP-80: Bronze Gate, Globe, Angle and Check Valves.
5. SP-85: Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
6. SP-110: Ball Valves, Threaded and Solder Joint Ends.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Anvil International, "Gruvlok" Series.
2. Conbraco/Apollo Industries
3. Hammond Valve
4. Milwaukee Valve Company
5. NIBCO, Inc.
6. Stockham
7. Victaulic Company of America

2.2 VALVES, GENERAL

- A. Valve Type/Manufacturer: Valves of same type shall be of same manufacturer.
- B. Refer to Part 3 "Valve Applications" Article for applications of valves.
- C. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- D. Brass Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- E. Iron Valves: NPS 2-1/2 and larger with flanged ends or grooved ends, unless otherwise indicated.
- F. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- H. Valve Actuators:
 1. Handwheel: For valves other than quarter-turn types.
 2. Lever Handle: For quarter-turn valves NPS 6 and smaller.
- I. Extended Valve Stems: On insulated valves.
- J. Valve Flanges: ASME B16.10 for iron valves; ASME B16.24 for bronze valves.
- K. Valve Grooved Ends: ASME/AWWA C606.

2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, General: MSS SP-110.
- B. Two-Piece Ball Valves: Bronze body with full port, hard chrome-plated solid brass or bronze ball, reinforced TFE seats and PTFE packing, adjustable packing nut, blowout-proof brass stem, threaded ends; 150 SWP/600 WOG.
 - 1. Milwaukee BA-400, or equal.

2.4 IRON BODY BUTTERFLY VALVES

- A. Iron Body Butterfly Valves, General: MSS SP-67, bubble tight seal. Select lug (flanged) body type where dead-end service is required to remove downstream piping for equipment removal or maintenance. Select wafer (flangeless) body type for other applications.
- B. Butterfly Valves: Cast iron body, aluminum bronze disc, 416 stainless steel two-piece stem design, field replaceable hard phenolic backed EPDM liner, non-metallic stem journal, blowout-proof stem, extended neck for 2 inch insulation, 10-position lever-lock handle with memory position plate for sizes NPS 6 and Smaller, lug or wafer body type; 200 WOG.
 - 1. Milwaukee CW/CL or MW/ML Series, or equal.
- C. Grooved-End, Butterfly Valves: ASTM A 536 ductile iron body, electroless nickel, aluminum bronze, or stainless steel offset disc, EPDM seat with full continuous contact, EPDM stem seals, 10-position lever-lock handle or gear operator; 300 WOG.
 - 1. Anvil "Gruvlok" 7700 Series.
 - 2. Victaulic Vic-300 Mater-Seal Series.

2.5 GROOVED NON-FERROUS ALLOY BUTTERFLY VALVES

- A. Grooved-End, Non-Ferrous Butterfly Valve: 300 CWP rating, cast bronze body, elastomer encapsulated ductile iron disc, with grooved ends manufactured to copper-tube dimensions.
 - 1. Anvil "Gruvlok" 7721 Series.
 - 2. Victaulic Series 608.

2.6 BRONZE CHECK VALVES

- A. Bronze Check Valves, General: MSS SP-80.
- B. Horizontal Swing Check Valves: Bronze body, threaded cap, bronze or TFE disc, integral bronze seats, threaded ends; 125 SWP/200 WOG.
 - 1. Milwaukee 509, or equal.
- C. Horizontal Swing Check Valves: Bronze body, threaded cap, TFE disc, integral bronze seats, threaded ends; 150 SWP/300 WOG.
 - 1. Milwaukee 510-T, or equal.
- D. Horizontal Swing Check Valves: "Y" pattern swing, bronze body, threaded cap, regrindable bronze disc, stainless steel hinge pins, integral bronze seats, threaded ends; 200 SWP.
 - 1. Milwaukee 508, or equal.

2.7 IRON BODY SWING CHECK VALVES

- A. Iron Body Swing Check Valves, General: MSS SP-71.
- B. Horizontal Swing Check Valves: Cast iron body, bronze trim, bolted bonnet, bronze or cast iron disc, bronze seat ring, flanged ends; 125 SWP/200 WOG.
 - 1. Milwaukee F2974, or equal.

2.8 SPRING-LOADED, LIFT-DISC CHECK VALVES

- A. Bronze Spring-Loaded Lift-Disc Check Valves: Bronze body, non-slam, in-line spring lift check, TFE disc, bronze or TFE seat, bronze or stainless steel spring, threaded ends; 250 WOG.
 - 1. Milwaukee 548T, or equal.
- B. Iron Body Compact-Wafer, Lift-Disc Check Valves: Wafer (flangeless) style, non-slam, cast iron body, bronze trim and disc, center guided, stainless steel springs and screws; 125 SWP/200 WOG.
 - 1. Milwaukee 1400, or equal.

- C. Ductile Iron Spring-Assisted, Check Valves: Grooved style, non-slam, ductile iron body, aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft; 300 CWP.
 - 1. Victaulic Series 716.

2.9 BRONZE GATE VALVES

- A. Bronze Gate Valves, General: MSS SP-80.
- B. Gate Valves: Bronze body, union bonnet, rising stem, malleable iron handwheel, solid bronze wedge, non-asbestos packing, gland follower, threaded ends; 150 SWP/300 WOG.
 - 1. Milwaukee 1151, or equal.

2.10 CAST-IRON GATE VALVES

- A. Cast-Iron Gate Valves, General: MSS SP-70.
- B. Gate Valves: Cast iron body, bolted bonnet, OS&Y, rising stem, bronze trim, cast iron handwheel, solid wedge, non-asbestos packing, gland follower, flanged ends; 125 SWP/200 WOG.
 - 1. Milwaukee F2885, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine grooved ends for conditions that might cause leakage. Ends should be free from indentations or projections in the area from valve end to groove.
- F. 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.
- G. Do not attempt to repair defective valves; replace with new valves.

3.2 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. Gate valves to be used only where specifically indicated.
 - 2. Throttling Service: Ball valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified SWP or WOG ratings are not available, the same types of valves with higher SWP or WOG ratings may be substituted.
- C. DOMESTIC WATER PIPING: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: 600 WOG, bronze body.
 - 2. Butterfly Valves, NPS 2-1/2 to NPS 12: 200 WOG, iron body.
 - 3. Butterfly Valves, NPS 2-1/2 to NPS 12: 300 WOG, ductile iron body.
 - 4. Swing Check Valves, NPS 2 and Smaller: 125 SWP/200 WOG, bronze body.
 - 5. Swing Check Valves, NPS 2-1/2 and Larger: 125 SWP/200 WOG, bronze trim, iron body.
 - 6. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: 250 WOG, bronze body.
 - 7. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: 125 SWP/200 WOG, wafer style, bronze trim, iron body.
 - 8. Gate Valves, NPS 2-1/2 and Larger: 125 SWP, bronze trim, iron body.
- D. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
 - 2. For Copper Tubing, NPS 2-1/2 and NPS 3: Threaded, grooved or flanged ends.
 - 3. For Copper Tubing NPS 4 and Larger: Flanged or grooved ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 and Larger: Flanged or grooved ends.
 - 6. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved.

3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Compact-Wafer Lift-Disc Check Valves: In horizontal or vertical position, between flanges.
- F. Install unions adjacent to each threaded end valve and at final connection to each piece of equipment.
- G. Install flanges adjacent to flanged valves and at final connections to each piece of equipment.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. . All grooved couplings, fittings, valves, and specialties shall be of the same manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. 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 inspect the product installation. Contractor shall remove and replace any improperly installed products.

3.5 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 220523

SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes hangers and supports for plumbing piping and equipment.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers:
 - a. Anvil International, Inc.
 - b. Globe Pipe Hanger Products, Inc.
 - c. Erico/Michigan Hanger Co., Inc.
 - d. PHD Manufacturing, Inc.
 - e. Thomas & Betts
 - f. Tolco Inc.
 - g. Unistrut Corp.
 - 2. Channel Support Systems:
 - a. Erico/Michigan Hanger Co., Inc.; O-Strut Div.
 - b. Thomas & Betts Corp.
 - c. Tolco Inc.
 - d. Unistrut Corp.
 - 3. Thermal-Hanger Shield Inserts:
 - a. Erico/Michigan Hanger Co., Inc.
 - b. PHS Industries, Inc.
 - c. Pipe Shields, Inc.
 - d. Rilco Manufacturing Co., Inc.
 - e. Value Engineered Products, Inc.

4. Pipe Stands
 - a. Erico/Michigan Hanger Co., Inc.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.

2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 1. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
 2. Nonmetallic Coatings: Plastic coating, jacket or liner.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 2. Nonmetallic Coatings: Plastic coating, jacket or liner.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
 1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 2. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 4. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 5. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-wedge type zinc-coated steel, for use in hardened Portland cement with pull-out, tension and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 4. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
 - 6. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.

- c. Heavy (MSS Type 33): 3000 lb.
- 10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units. Make allowance for pipe insulation as required.
- E. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- G. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9.
 - 2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

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

3.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting.

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- B. Galvanized Surfaces: Clean welds, bolted connections and abraded area and apply galvanizing repair paint.

3.7 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 220529

SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following plumbing identification materials and their installation:
 - 1. Equipment markers.
 - 2. Access panel and door markers.
 - 3. Pipe markers.
 - 4. Valve tags.
 - 5. Valve schedules.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

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 IDENTIFICATION DEVICES

- A. 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.
 - 3. Size: 2-1/2 by 4 inches for equipment.
- B. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide two, 1/8-inch holes for attachment.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Either full-band pipe markers extending 360 degrees around pipe at each location or strip-type pipe markers..
 - 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with approved numbering scheme . Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick brass
 - 2. Material: 3/32-inch- thick laminated plastic with 2 black surfaces and white inner layer.
 - 3. Valve-Tag Fasteners: Brass wire-link or beaded chain.
 - 4. Size: 1-1/2 inch diameter (minimum).

2.4 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.
 - 2. Frame: Extruded aluminum.
 - 3. Glazing: Single-thickness glass.

PART 3 - EXECUTION

3.1 GENERAL

- A. All identification shall use the room numbers assigned by the Owner. Obtain a list of room numbers from the Owner's Representative prior to preparing identification.

3.2 EQUIPMENT IDENTIFICATION

- A. Install equipment markers with permanent adhesive on or near each major item of plumbing equipment.
 - 1. Letter Size: Minimum 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances.
 - 2. Locate markers where accessible and visible from ground or floor level. Include markers for the following general categories of equipment:
 - a. Meters, and similar units.
 - b. Pumps and similar motor-driven units.
 - c. Tanks and pressure vessels.
 - d. Water-treatment systems, and similar equipment.
- B. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pre-tensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe for strip-type pipe markers.
 - 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

- B. Locate pipe markers and color bands where piping is exposed in finished spaces; mechanical rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible 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 along each run. Reduce intervals in areas of congested piping and equipment.
 - 7. Piping above removable acoustical ceilings. .

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 similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.7 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.8 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 220553

SECTION 220700 – PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes insulation systems for plumbing equipment, and piping.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. PVC: Polyvinyl chloride.
- D. SSL: Self-sealing lap.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. For adhesives, sealants and mastics: Documentation including printed statement of VOC content.

1.5 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, 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.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application.

1.8 SCHEDULING

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

1.9 Complete installation and concealment of plastic materials as rapidly as possible in each area of construction

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. Nomaco K-Flex.

- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation without jacket or with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- H. Mineral-Fiber, Preformed Pipe Insulation:
1. Products:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 deg. Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 4. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 3. Solids Content: 63 percent by volume and 73 percent by weight.
 - 4. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire and water resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color:
 - a. White for ASJ and PVC.
 - b. Aluminum for FSK and metal jackets.
- B. VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - 1. Adhesive: As recommended by jacket material manufacturer.
 - 2. Color: White.
 - 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps and mechanical joints.

4. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, Temper H-14; sheet and roll stock ready for shop or field sizing.
 - a. Finish and thickness: Stucco embossed; .016-inch thick minimum.
 - b. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

- A. ASJ Tape: White vapor-barrier tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
- B. FSK Tape: Foil-face, vapor-barrier tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
- C. PVC Tape: White vapor-barrier tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- D. Aluminum-Foil Tape: Vapor-barrier tape with acrylic adhesive and UL listed.

2.9 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, length to suit depth of insulation indicated.
2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.

- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
- D. Bands: Stainless-steel or aluminum with wing seals.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or barriers, jackets, and thicknesses required for each item of equipment, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 to 6 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Non-Rated Interior Wall and Partition Penetrations): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Division 07 Section "Fire-Resistive Joint Systems" and 22 Section "Common Materials and Methods for Plumbing".
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies according to Division 07 Section "Fire-Resistive Joint Systems" and Division 22 Section "Common Materials and Methods for Plumbing".

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-barrier integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using reusable valve wrap, preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.
5. Insulate strainers using reusable valve wrap, preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
8. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
9. Install reusable valve wrap or removable insulating fabric fitting covers on valves, elbows, tees, and flanges, strainers or other irregularly-shaped fittings or components where fitted PVC covers are not practical or available.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install reusable valve wrap or preformed valve covers manufactured of same material as pipe insulation when available.
2. Install insulation to flanges as specified for flange insulation application.
3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 4 to 6 inches o.c.
3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.

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

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Fire-suppression piping.
 2. Drainage piping located in crawl spaces.
 3. Below-grade piping.
 4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Service: Domestic Hot and Recirculated Hot Water.
1. Operating Temperature: 60 to 140 deg F.
 2. Insulation Material: Mineral-Fiber.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 1-1/4 inch and less: 1.0 inch
 - b. Pipe, > 1-1/4 inch: 1.5 inch
 4. Field-Applied Jacket: PVC for piping exposed in public spaces to 9 feet above floor level.
 5. Vapor Barrier Required: None.
- C. Service: Domestic Cold Water.
1. Operating Temperature: 35 to 60 deg F.
 2. Insulation Material: Mineral-Fiber.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 2 inch and less: 0.5 inch
 - b. Pipe, > 2 inch: 1.0 inch
 4. Field-Applied Jacket: PVC for piping exposed in public spaces to 9 feet above floor level.
 5. Vapor Barrier Required: Yes.

END OF SECTION 220700

SECTION 220800 – COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 RELATED WORK

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

1.2 DESCRIPTION OF WORK

- A. This section describes the requirements for start-up and commissioning of Division 22 installed work.
- B. The Contractor shall test and provide written certification that the scheduled mechanical installation complies with contract documents, code, and proper system operation. Perform acceptance tests in accordance with manufacturer recommendations. Complete the installation and start-up checklists and testing procedures.
- C. The Contractor shall provide expert personnel to start-up and test components and systems described in this section and related sections.

1.3 SYSTEMS TO BE COMMISSIONED

- A. The following mechanical systems will be commissioned on this project. The mechanical contractor is required to provide qualified personnel to test these systems.
 - 1. Plumbing Fixtures, Faucets and Flush Valves.
 - 2. Water Heater.
 - 3. Backflow Preventers.
 - 4. Compressed Air System.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Comply with general industry standards and similar in scope to that required for similar HVAC systems in Washington State Energy Code Section 1416 as a minimum.

END OF SECTION 220800

SECTION 22 11 13 - FACILITY WATER DISTRIBUTION 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.
- B. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition. Except for the payment section.
- C. Any inconsistency in this section shall be resolved by application of the WSDOT Standard Specifications, most recent edition except for payment.
- D. Contractor shall conform to the recommendations outlined in the geotechnical report prepared by Grant County dated April 7, 2010. If the geotechnical report conflicts with these specifications contractor shall adhere to the more stringent.

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.

1.3 DEFINITIONS

- A. PE: Polyethylene plastic.
- B. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: All materials to be used in the construction of the water system improvements shall be submitted and approved prior to use. For each type of product indicated submit manufacturer's catalog information and any additional information as required. Submittals that do not meet the requirement of the project plans and specifications, or that do not provide sufficient information for a full review will be returned to the Contractor for a re-submittal.
 - 1. Pipe and fittings: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit valve data and ratings for each service.
- B. Shop Drawings: Detail precast concrete tank assemblies and indicate dimensions, reinforcing, method of field assembly, and components. Pre-cast concrete vault calculations to be completed by a professional engineer licensed in the state of Washington.

- C. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of the Grant County Health District, Washington State Department of Health, and Washington State Department of Ecology for supply water.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All pipe, fittings, meters, tanks, and valves shall be supplied by the Contractor.
- B. Preparation for Transport: Prepare valves, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- C. During Storage: Use precautions for valves according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Coordinate connection to water existing services with Grant County Public Works Department and in accordance with Grant County Health District Regulations.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. PVC Pipe less than 4 inches in diameter:
 - 1. Pipe: Class 200 SDR 21 PVC Pipe, ASTM D 2241
 - 2. Fittings: Solvent Weld Fittings, ASTM D 2672
 - 3. Solvent Cement: ASTM D 2564
 - 4. Primer: ASTM F 656
- B. PVC Pipe 4 inches or larger in diameter: AWWA C900, Class 200 with bell end with gasket, and with spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
 - 3. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 PE PIPE AND FITTINGS

- A. PE, ASTM Pipe: ASTM D 2239, SDR No. 7; with PE compound number required to give pressure rating not less than 200 psig.
 - 1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

2.3 JOINING MATERIALS

- A. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise specified in the WSDOT Standard Specifications.

2.4 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.5 CORPORATION VALVES AND CURB VALVES

- A. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
- B. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.6 WATER STORAGE FIRE TANK

- A. 7,500 gallon capacity precast concrete tank.
 - 1. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
- B. Frames and Covers: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading.
 - 1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the WSDOT Standard Specifications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.

- D. Underground Combined Water-Service and Fire-Service-Main Piping shall be any of the following:
 - 1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
 - 2. PVC, AWWA C900 pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for underground installation. Use corporation valves and curb valves with ends compatible with piping furnished.

3.4 PIPING INSTALLATION

- A. Water-Service Connection: Coordinate with Grant County Public Works Department for connection into existing well service.
- B. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- C. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- D. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- E. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 ANCHORAGE INSTALLATION

- A. Install 6" AWWA C900 PVC water-distribution piping with restrained joints:
 - 1. PVC bell restraints shall be Mega-Lug Series 1500 bell restraining harness as manufactured by EBAA Iron, or approved equal.
 - 2. All bends and fittings shall be ductile or gray-iron installed with Mega-Lug Series 2000PV mechanical joint restraint as manufactured by EBAA Iron, or approved equal.
 - a. Restraint lengths for bends and fittings are as follows:
 - 1) 6" 45-Degree Bends: Restrain 17' on each side of bend
 - 2) 6" 90-Degree Bends: Restrain 7' on each side of bend
 - 3) 6" x 2" Reducer: Restrain 35' on 6" side of reducer

- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.7 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault adjacent to fire storage tank.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.8 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.9 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water-distribution piping to existing water services at site.

3.10 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts

(1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

- C. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Install continuous insulated copper No. 12 AWG wire. Wire shall be taped directly to the top of the pipe and extend in a coil fashion into the valve box, near the top of the box.
- B. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate tape below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - c. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

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 SUMMARY

- A. This Section includes domestic water piping and water meters inside the building.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and fittings.
 - 2. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.3 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.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings and water meters.
- B. Water Samples: Specified in "Cleaning" Article in Part 3.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

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. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

- C. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 3. 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.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
 1. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 2. 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.
 3. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings

2.3 VALVES

- A. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for bronze and cast-iron, general-duty valves.
- B. Refer to Division 22 Section "Domestic Water Piping Specialties" for balancing and drain valves.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" 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 Option: Mechanically formed tee-branch outlets and brazed joints may be used on aboveground copper tubing.

- E. Pipe Bending Option: Pipe bending of Types K and L copper tube permitted when bends are made with no kinks, ripples, distortions or reductions in diameter or any noticeable deviations from round. Minimum radius shall be 6 pipe diameters for pipe NPS 2 and smaller, and 5 pipe diameters for pipe NPS 2-1/2 and larger.
- F. Underground Domestic Water Service Piping: Use the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Soft copper tube, Type K copper pressure fittings; and brazed joints.
- G. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:
 - 1. NPS 6 and Smaller: Hard copper tube, Type L copper pressure fittings; and soldered joints.
 - 2. NPS 4 to NPS 6: Hard copper tube, Type L with grooved ends; copper grooved-end fittings.

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: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Cast-iron, grooved-end valves may be used with grooved-end piping.

3.4 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic piping installation.
- B. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- C. Install copper tubing according to CDA's "Copper Tube Handbook."
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service.
- E. Install aboveground domestic water piping level without pitch and plumb.
- F. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- G. 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.
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.

- H. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- I. Check plumbing specialties and verify proper settings, adjustments, and operation.
- J. Energize pumps and verify proper operation.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, 95-5 tin antimony solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. Grooved Joints: Assemble joints with keyed-coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. 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.

3.6 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops.
- C. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 2. Install stop-and-waste drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow.
- E. Do not install valves over electrical outlets or electrical equipment.
- F. Valves shall be installed so they are easily accessible for maintenance.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- 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.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

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.
- D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:
 - 1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union or flange for each connection.

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.

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.

3.10 ADJUSTING

- A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

3.11 CLEANING

A. 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.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or 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 the following:
 - c. 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.
 - d. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

- B. Prepare and submit reports of purging and disinfecting activities. Provide one copy of cleaning report and acceptance report from a certified laboratory or Health Department upon completion of cleaning and disinfecting activities.

- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 221116

SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 1. Backflow preventers
 2. Strainers
 3. Outlet boxes
 4. Key-operation hydrants
 5. Trap seal primer valves
 6. Drain valves
 7. Miscellaneous piping specialties
- B. Related Sections include the following:
 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, and pressure gages.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 1. Domestic Water Piping: 125 psig.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Maintenance Data: For domestic water piping specialties 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, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water piping specialties.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Operating Key Handles: Equal to 100 percent of amount installed for each key-operated hose bibb and hydrant installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers listed.

2.2 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Zurn Industries, Inc.; Wilkins Div.
- B. General: ASSE standard, backflow preventers.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or stainless-steel body with flanged ends.
 - 3. Interior Components: Corrosion-resistant materials.
 - 4. Strainer: On inlet.
- C. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- D. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between two positive-seating check valves. Stainless steel construction for water supply serving carbonated water beverage systems.
 - 1. NPS 2 and Smaller: Quarter-turn, full-port ball valves.
 - 2. NPS 2-1/2 and Larger: Quarter-turn, full-port ball valves.
 - 3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

2.3 STRAINERS

- A. Manufacturers:
 - 1. Conbraco Industries, Inc.
 - 2. Mueller Steam Specialty
 - 3. Spirax Sarco, Inc.
 - 4. Victaulic Company of America.
 - 5. Watts Industries, Inc.

- B. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens .
 - 1. Pressure Rating: 125-psig minimum steam working pressure, unless otherwise indicated.
 - 2. NPS 2 and Smaller: Bronze body, with female threaded ends; 20 mesh, 0.033-inch openings.
 - 3. NPS 2-1/2 and Larger: Cast-iron body, ANSI 125 flanged ends; 20 mesh, 0.033-inch openings for steam and water service to NPS 3; 0.045-inch perforations for steam service NPS 4 to NPS 6; 0.062-inch perforations for steam service NPS 8 and larger; 0.125-inch perforations for water service NPS 4 and larger.
 - 4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
 - a. Drain: Factory- or field-installed, hose-end drain valve.

2.4 OUTLET BOXES

- A. Manufacturers:
 - 1. Acorn Engineering Company.
 - 2. Guy Gray Manufacturing Co., Inc.
 - 3. IPS Corporation.
 - 4. LSP Products Group.
 - 5. Oatey.
 - 6. Plastic Oddities, Inc.
 - 7. Symmons Industries, Inc.
 - 8. Zurn Industries, Inc.
- B. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections.
- C. Icemaker Outlet Boxes: With hose connection and the following:
 - 1. Box and Faceplate: Enameled or epoxy-painted steel.
 - 2. Shutoff Fitting: 1/2 inch FIP inlet compression angle valve.
 - 3. Schedule (Referenced Manufacturer: Guy Gray Manufacturing Co.):
 - a. Symbol "ICE": Guy Gray Model BIM875

2.5 KEY-OPERATION HYDRANTS

- A. Manufacturers:
 - 1. Acorn Engineering.
 - 2. Josam Co.
 - 3. MIFAB
 - 4. Prier Brass
 - 5. Smith, Jay R. Mfg. Co.
 - 6. Tyler Pipe; Wade Div.
 - 7. Watts Industries, Inc.
 - 8. Woodford Manufacturing Co.
 - 9. Zurn Industries, Inc
- B. General: ASSE 1019, key-operation hydrant with pressure rating of 125 psig.
 - 1. Inlet: NPS 3/4 threaded joint.
 - 2. Outlet: ASME B1.20.7, garden-hose threads.

- C. Exterior Non-freeze Wall Hydrants: Self-drainable with integral non-removable hose-connection vacuum breaker or backflow preventer, casing and operating rod to match wall thickness, one-half turn ceramic disk cartridge, stainless-steel box and hinged cover, operating key.

- 1. Schedule (Referenced Manufacturer: Zurn Industries, Inc.):
 - a. Symbol "NFWH": Zurn Model Z-1320

2.6 TRAP SEAL PRIMER VALVES

- A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:

- 1. Manufacturers:
 - a. Josam Co.
 - b. MIFAB
 - c. Precision Plumbing Products, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Sioux Chief Manufacturing Co.
 - f. Watts Industries, Inc.
- 2. 125-psig minimum working pressure.
- 3. Field serviceable.
- 4. Activated with a 3 psig pressure drop.
- 5. Bronze body with atmospheric-vented drain chamber.
- 6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
- 7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

- B. Vacuum Breaker Type Trap Seal Primer Valves: ASSE 1044, Chrome-plated, cast-brass, NPS 1-1/2, flushometer valve vacuum breaker with NPS 3/8 outlet tubing.

- 1. Manufacturers:
 - a. Smith, Jay R. Mfg. Co.
 - b. Zurn Industries, Inc.

2.7 DRAIN VALVES

- A. Hose-End Drain Valves: MSS SP-110, NPS 3/4 ball valve, rated for 400-psig minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.

- 1. Inlet: Threaded or solder joint.
- 2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.

- B. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with NPS 1/8 side drain outlet and cap.

2.8 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

- 1. Manufacturers:
 - a. Amtrol, Inc.
 - b. Josam Co.

- c. MIFAB
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Co., Inc.
 - f. Watts Industries, Inc.
 - g. Zurn Industries, Inc.; Wilkins Div.
- B. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig; integral or field-installed, nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
- 1. Finish for Equipment Rooms: Rough bronze, chrome or nickel plated.
 - 2. Finish for Service Areas: Rough bronze, Chrome or nickel plated.
 - 3. Finish for Finished Rooms: Chrome or nickel plated.
 - 4. Operation for Equipment Rooms: Wheel handle or operating key.
 - 5. Operation for Service Areas: Wheel handle.
 - 6. Operation for Finished Rooms: Wheel handle.
 - 7. Include operating key with each operating-key hose bibb.
 - 8. Include integral wall flange with each chrome- or nickel-plated hose bibb.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers where indicated; in same room as connected equipment or system where possible if not specifically indicated.
 - 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. Backflow preventers installed more than 5 feet above floor or ground level shall have a permanent platform under for maintenance personnel to stand on.
 - 4. Do not install bypass piping around backflow preventers.
 - 5. Test each backflow prevention assembly by a Washington State Department of Health (DOH) certified tester at the time of installation. Furnish written report of test to Owner and authority having jurisdiction. Provide one copy to the Commissioning Authority for enclosure with commissioning report.
- C. Install strainers on supply side of each control valve, water regulator, and solenoid valve.
- D. Install plumbing pumps according to manufacturer's written instructions and with access for periodic maintenance, including removing motors, impellers, couplings, and accessories. Do not install pumps higher than 6 feet above finished floor without approval from the Owner and Engineer.

- E. Install thermostatic water mixing valves and required specialties in accordance with manufacturer's instructions. Provide heat trap of recommended depth in hot water inlet piping where required by mixing valve location, check valves and adjusting valves as required. Adjust mixing valves in accordance with manufacturer's instructions. Furnish written report to include in Operation and Maintenance Manual.
- F. Trap seal primers are not generally indicated on the Drawings. Trap seal primers shall be drainage-type used with flushometer valves. At locations remote from a flushometer valve fixture, or where indicated on the drawings, trap seal primers shall be supply-type trap seal primer valves.
- G. Locate trap seal primers in accessible locations. Where located in finished area, conceal in wall and provide access door. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain, floor-sink, or open-hub drain or other drain body, trap, or inlet fitting. Adjust valve for proper flow.
 - 1. Outlet Piping: Soft copper tube, Type K; CPVC "Gold" Schedule 40 with socket type fittings; or crosslinked polyethylene (PEX) tubing and barbed or compression adapter fittings.
- H. Size and install water hammer arresters in accordance with manufacturer's recommendations and instructions. Install arresters at quick-closing valves, solenoid valves, and at each plumbing fixture or battery of fixtures in domestic water systems. Arrestors shall be accessible for servicing or replacement.
- I. Install individual shutoff valve in each water supply to water piping specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Install shutoff valve and strainer on suction side of circulator pumps, and check valve and balancing valve on discharge side of pumps. Install valves same size as connected piping.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each thermostatic water mixing valve and backflow preventer.
 - 1. Refer to Division 22 Section "Identification for Plumbing Piping and Equipment" for nameplates and signs.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.

3.5 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 –Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 221119

SECTION 22 13 13 – FACILITY SANITARY SEWERS

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. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition. Except for the payment section.
- C. Any inconsistency in this section shall be resolved by application of the WSDOT Standard Specifications, most recent edition except for payment.
- D. Contractor shall conform to the recommendations outlined in the geotechnical report prepared by Grant County dated April 7, 2010. If the geotechnical report conflicts with these specifications contractor shall adhere to the more stringent.
- E. WA DOH Publication #337 – 009 Pressure Distribution Systems – Recommended Standards and Guidance, Effective Date: July, 2009, apply to this section.
- F. Chapter 246-272 and 246-272A WAC On-site Sewage Systems: Rules and Regulations of the State Board of Health and all current Amendments or Additions apply to this section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Septic tanks and tank filters.
 - 2. Pressure distribution chambers.
 - 3. Pump vaults, motors and controllers
 - 4. Pipe and fittings, including cleanouts.
 - 5. Drainage beds.

1.3 PERFORMANCE REQUIREMENTS

- A. Pressure Distribution Systems:
 - 1. **Intent**
The intent of pressure distribution is uniform distribution of effluent throughout the receiving component.
 - 2. **Measure of Performance**
 - a. Refer to WA DOH Publication #337-009 for guidance.

1.4 DEFINITIONS

- A. OSS: On-site sewage system.
- B. SSAS: Subsurface soil absorption system.
- C. Bed: A soil dispersal component consisting of an excavation with a width greater than three feet.
- D. Distribution technology: Any arrangement of equipment and/or materials that distributes sewage within an on-site sewage system.
- E. Installer: A person approved by the local health officer to install on-site sewage systems or components.
- F. On-site sewage system (OSS): An integrated system of components, located on or nearby the property it serves, that conveys, stores, treats, and/or provides subsurface soil treatment and dispersal of sewage. It consists of a collection system, a treatment component or treatment sequence, and a soil dispersal component. An on-site sewage system also refers to a holding tank sewage system or other system that does not have a soil dispersal component.
- G. Pressure distribution: A system of small diameter pipes equally distributing effluent throughout a SSAS, as described in the department's "Guidance for Pressure Distribution Systems". Also see Chapter 246-272 & 272A WAC.
- H. Subsurface soil absorption system (SSAS): A soil dispersal component of trenches or beds containing either a distribution pipe within a layer of drainrock covered with a geotextile, or an approved gravelless distribution technology, designed and installed in original, undisturbed, unsaturated soil providing at least minimal vertical separation as established in Chapter 246-272 & 272A WAC, with either gravity or pressure distribution of the treatment component effluent..
- I. RS&G: Recommended Standards and Guidance.
- J. Glossary of Terms: A common glossary of terms for all RS&Gs can be found on the DOH Web site at <http://www.doh.wa.gov/ehp/ts/ww/pubs-ww-rsg.htm#glossary>.
- K. See 246-272-0100 and 246-272A-0010, "Definitions" for additional definitions.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Septic tanks and pressure chambers.
 - 2. Septic tank filters.
 - 3. Screened pump vaults
 - 4. Pumps and motors.
 - 5. Pump Control panels and systems.
 - 6. Pipe and fittings, including valves

- B. Shop Drawings: Include manhole openings, risers, covers, pipe connections, and accessories for the following precast concrete structures:
 - 1. Septic tanks.
 - 2. Pump chamber tanks.
 - 3. Wiring diagram for power, control wiring, signal and alarm circuits.

- C. Coordination Drawings: Show piping, underground structures, and other utilities. Indicate size and invert elevations of piping and structures. Indicate pump level control heights such as pump on, pump off, high water warning and redundant off referenced against pump chamber floor or elevation control measure.

- D. User’s Manual: The Contractor must submit for approval as part of the design submittal for the pressure distribution system at a minimum, the following:
 - 1. Diagrams of the system components.
 - 2. Explanation of general system function, operational expectations, owner responsibility, etc.
 - 3. Specifications of all electrical and mechanical components to be installed.
 - 4. Names and telephone numbers of the system designer, local health jurisdiction, component manufacturers, supplier/installer, and/or the management entity to contact in the event of a failure.
 - 5. Information regarding the periodic maintenance requirements of the various components of the sewage system, and
 - 6. Information on “trouble-shooting” and common operational problems that might occur. This information should be as detailed and complete as needed to assist the system owner to make accurate decisions about when and how to attempt corrections of operational problems, and when to call for professional assistance.

1.6 QUALITY ASSURANCE

- A. WA DOH Compliance: Comply with the regulations set forth in Chapters 246-272 & 246-272A WAC – Onsite Sewage Systems

- B. Local Management and Regulation: Comply with any additional requirements and/or regulations as established by the Grant County Health District. Contact the health officer to ensure all costs associated with construction, inspection, testing and other quality assurance requirements specific to Grant County are accounted for in the Contractors bid..

- C. Product Options: Drawings indicate sizes, profiles, and dimensional requirements for a particular distribution technology and are based on the specific system indicated.

- 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.

1.7 PROJECT CONDITIONS

- A. The plans reference one manufacturers’ system and indicate sizes, profiles, and dimensional requirements for a particular distribution technology consistent with the manufacturers’ system.

The plans provide the Contractor with representation of required system components for the purpose of estimating and bidding. The Contractor shall inspect the Site, consult installers of distribution technologies and make any other investigations deemed necessary to assure all costs associated with construction, installation and final approval of the submitted and approved system are addressed and included in the bid.

- B. Do not store plastic pipe or fittings in direct sunlight.
 - C. Protect pipe, pipe fittings and other system components from dirt and damage.
- D. Protect proposed onsite seepage bed site from stockpiling of materials, routing or equipment storage or other operations deemed potentially harmful to site.
- E. Handle and store tanks, vaults and other structures according to manufacturer's recommendations.

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, manufacturers specified.
 - 1. On-site Wastewater Components and Packaged Systems:
 - a. Orenco Systems Incorporated
 - b. Advantex Treatment Systems
 - c. Automated Flow Systems
 - d. Geoflow
 - e. Xerxes Corporation
 - f. Hydromatic
 - g. SJE - Rhombus

2.2 DISTRIBUTION PIPES AND FITTINGS

- A. Piping Materials:
 - 1. At a minimum, the material must meet ASTM D2241 Class 160 or equivalent.
 - 2. For schedule 40 and schedule 80 PVC, use ASTM D1785.

2.3 SEEPAGE BED-FIELD MATERIALS

- A. Filtering Material: ASTM D 448, Size No. 24, 3/4 to 2-1/2 inches, washed, crushed stone or gravel, or as approved by Grant County Health Department.
- B. Filter Mat: Geotextile woven or spun filter fabric, in 1 or more layers, for minimum total unit weight of 3 oz./sq. yd or as approved by Grant County Health Department.

- C. Fill Material: Soil removed from trench.

2.4 SAND LINED SEEPAGE BED MATERIALS

A. Particle Size Analysis

1. The standard method to be used for performing particle size analysis must comply with one of the following:
 - a. The sieve method specified in ASTM D136 and ASTM C-117.
 - b. The method specified in Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil survey Investigation Report #1, US Department of Agriculture, 1984.

2. Sand Lined Drainfield Trench Filter Media (ASTM C-33)

The filter media must meet either specification a or specification b, below as determined by section A Particle Size Analysis. Media may be either mineral sand or equivalently sized crushed glass.

a. Coarse Sand Media Specification

The filter media must meet items 1), 2), and 3), below: (Source: State of Oregon On-Site Sewage Disposal Rules and the State of Wisconsin Single Pass Sand Filter Component Manual).

- 1) Particle size distribution

COARSE SAND PARTICLE SIZE DISTRIBUTION

<u>Sieve</u>	<u>Particle Size</u>	<u>Percent Passing</u>
3/8 in	9.50 mm	100
No. 4	4.75 mm	95 to 100
No. 8	2.36 mm	80 to 100
No. 16	1.18 mm	45 to 85
No. 30	0.6 mm	15 to 60
No. 50	0.3 mm	3 to 15
No. 100	0.15 mm	0 to 4

- 2) Effective Particle Size (D10) > 0.3 mm.
- 3) Uniformity Coefficient (D60/D10) < 4.0

b. ASTM C-33 Media Specification

- 1) The filter media must meet items a), b), c), and d), below: (Source: ASTM C-33-03, Specification for Fine Aggregate)

- a) Particle size distribution:

FINE AGGREGATE PARTICLE SIZE DISTRIBUTION

<u>Sieve</u>	<u>Particle Size</u>	<u>Percent Passing</u>
3/8 in	9.50 mm	100
No. 4	4.75 mm	95 to 100
No. 8	2.36 mm	80 to 100
No. 16	1.18 mm	50 to 85
No. 30	0.6 mm	25 to 60
No. 50	0.3 mm	5 to 30
No. 100	0.15 mm	0 to 10 (prefer <4)

[For No. 200 sieve, see note (d).]

- b) The sand must have not more than 45% passing any one sieve and retained on the next consecutive sieve, of those shown above.
- c) The fineness modulus must not be less than 2.3 or more than 3.1, and is defined as a numeric quantity to control the distribution of filter media particle sizes within the specified range for sand lined trenches/beds. The fineness modulus is calculated by adding the cumulative percents of samples retained in the sieves shown above, dividing the sum by 100.
- d) The limit for material that can pass the No. 200 sieve must not be more than 3%. Nothing passing the No. 200 sieve is preferred.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements and other conditions affecting performance of pressure distribution systems.
- B. Verify compatibility with and suitability of soil structure and materials.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

- A. Excavating, trenching, and backfilling for piping and seepage beds as specified in Section 31 20 00 "Earth Moving."
 - 1. Stockpile topsoil for reuse in finish grading without intermixing with other excavated material. Stockpile materials away from edge of excavation.
 - 2. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
- B. Excavating and Backfilling for Septic Tank and Pressure Tank:

1. Excavate sufficient width and length for tanks to depth determined by tank inlet elevation. Provide level bottom.
 2. Backfill with excavated soil, compacting around and against tanks as recommended by tank manufacturer.
- C. Excavating and Backfilling for Sand Lined Seepage Beds:
1. Excavate for seepage bed in the dimensions and at the approximate location shown on the plans
 2. Backfill seepage bed with the pre-approved media, gravel and excavated soils in the thickness shown on the plans, without compacting.

3.3 SEPTIC TANK INSTALLATION

- A. Install septic tanks level according to ASTM C 891.
- B. Install septic tanks plumb and level.
- C. Install filter in septic tank outlet. Secure filter to septic tank wall. Make direct connections to pump chamber tank.
- D. Fill septic tank with water.

3.4 PUMP CHAMBER INSTALLATION

- A. Install pump chamber level and according to ASTM C 891.
- B. Install pump vault components and lifting apparatus. Make direct connections to transport piping.
- C. Set submersible effluent pump on vault floor. Make direct connections to transport piping.
- D. Set float levels in initial measured positions.
- E. Complete electrical connections
- F. Fill pressure chamber with water.

3.5 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

3.6 SEEPAGE BED -FIELD INSTALLATION

- A. Install transport piping at minimum slope of 1 percent and maximum slope of 2 percent.

- B. Install distribution piping solidly bedded in filtering material, with full bearing for each pipe section throughout its length. Maintain pipe alignment with no slope.
 - 1. Install perforated pipe with perforations down and joints tightly closed. Install collars and couplings as required.
 - 2. Install elbow fittings with tight joints.
 - 3. Place additional filtering material around sides to a minimum compacted depth of 2 inches above the top of distribution piping.
- C. Install filter mat over filter material before backfilling.

3.7 IDENTIFICATION

- A. Arrange for installation of green warning tape directly over piping (including seepage bed piping), at outside edges of underground structures, and at outside edges of seepage bed.
- B. Use detectable warning tape over piping, over edges of underground structures, and over edges of seepage beds.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- 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."

3.9 FIELD QUALITY CONTROL

- A. System Tests: Perform testing of completed pressure distribution system piping and structures according to Grant County Health District standards.
- B. Additional Tests: Fill underground structures with water and let stand overnight. If water level recedes, locate and repair leaks and retest. Repeat tests and repairs until no leaks exist.

3.10 CLEANING

- A. Clear interior of piping and structures of dirt and other superfluous material as work progresses.
- B. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of workday or when work stops.

END OF SECTION

SECTION 221316 – SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes soil and waste, sanitary drainage and vent piping inside the building and to locations indicated.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Waste Piping Specialties" for soil, waste, and vent piping systems specialties.

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. PVC: Polyvinyl chloride plastic.

1.4 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

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.6 QUALITY ASSURANCE

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

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 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: CISPI 301, ASTM A 888 or ASTM A 74, Service class. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be of domestic manufacturer.

- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and 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.

2.3 ABS PIPE AND FITTINGS

- A. Cellular-Core, ABS Pipe: ASTM F 628, Schedule 40.
- B. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

2.4 PVC PIPE AND FITTINGS

- A. Cellular-Core PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special 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: Use any of the following piping materials for each size range:
 - 1. NPS 1-1/2 to NPS 6: Hubless, cast-iron soil pipe and fittings, heavy-duty stainless steel couplings.
 - 2. NPS 1-1/2 to NPS 6: Cellular-core, ABS pipe; ABS socket fittings; and solvent-cemented joints. Not allowed in return air plenums.
 - 3. NPS 1-1/2 to NPS 6: PVC pipe, PVC socket fittings, and solvent-cemented joints. Not allowed in return air plenums.
- C. Underground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:
 - 1. NPS 2 to NPS 6: Hubless, cast-iron soil pipe and fittings, heavy-duty stainless steel couplings.
 - 2. NPS 2 to NPS 6: Cellular-core, ABS pipe; ABS socket fittings; and solvent-cemented joints.
 - 3. NPS 2 to NPS 6: PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.3 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic piping installation.
- B. Do not use ABS or PVC plastic piping in return air plenums.
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for wall penetration systems.
- 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."
- F. 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.
- G. Install vent piping free from drops or sags, graded and connected as to drip back by gravity to the drainage pipe it serves.
- H. 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.
- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
- H. Install supports for vertical ABS and PVC piping every 48 inches.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union or flange for each connection.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. 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. Provide a copy of leak testing report for sanitary drainage and vent piping to the Commissioning Authority if not witnessed.

3.8 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.

3.9 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 221316

SECTION 221319 – SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary waste drainage piping specialties:
 1. Miscellaneous piping specialties
 2. Flashing materials
 3. Cleanouts
 4. Floor drains

1.3 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 1. Sanitary Waste and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics.
- B. Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. NSF Compliance:
 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include marking "NSF-DWV" on plastic drain, waste, and vent piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers listed.

2.2 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

- A. Roof Piping and Conduit Flashings: One-piece, 18" x 18" 24 gage galvanized steel base with friction-seal, elastomeric sealing collar.
- B. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- C. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- D. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- E. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.

2.3 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4-lb/sq. ft., 0.0625-inch thickness.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.

2.4 CLEANOUTS

- A. Manufacturers:
 1. Josam Co.
 2. MIFAB
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe, Wade Div.
 5. Watts Industries, Inc., Drainage Products Div.
 6. Zurn Industries, Inc., Specification Drainage Operation
- B. Cleanouts, General: Comply with ASME A112.36.2M.
 1. Body or Ferrule Material: Cast iron.

2. Clamping Device: Required.
3. Outlet Connection: Spigot or no-hub.
4. Closure: Brass plug with tapered threads.
5. Adjustable Housing Material: Cast iron with threads.
6. Frame and Cover Material and Finish: Nickel-bronze.
7. Frame and Cover Shape: Round.
8. Top Loading Classification: Light Duty for finished interior floor service; Heavy Traffic Duty for exterior service.

C. Cleanout Schedule (Reference Manufacturer: Smith, Jay R. Mfg. Co):

1. Finished Floor: Smith, Jay R.; Fig. 4023S or Fig. 4033L.
2. Carpeted Floor: Smith, Jay R.; Fig. 4023S-X or Fig. 4033L-X.
3. Terrazzo Floor: Smith, Jay R.; Fig. 4183S or Fig. 4193L.
4. Wall: Smith, Jay R.; Fig. 4422C.
5. Exterior: Smith, Jay R.; Fig. 4253S or Fig. 4263L.

2.5 FLOOR DRAINS

A. Manufacturers:

1. Josam Co.
2. MIFAB
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe, Wade Div.
5. Watts Industries, Inc., Drainage Products Div.
6. Zurn Industries, Inc., Specification Drainage Operation

B. Floor Drains, General: Comply with ASME A112.21.1M.

1. Body Material: Cast iron.
2. Clamping Device: Required.
3. Outlet: Bottom.
4. Top of Body and Strainer Material: Nickel bronze or cast iron as scheduled.
5. Trap Material: Cast iron.
6. Trap Pattern: Standard P-trap.
7. Trap Features: Trap seal primer valve drain connection.

C. Floor Drain Schedule (Reference Manufacturer: Smith, Jay R. Mfg. Co):

1. FDB (standard finished floor drain with round adjustable strainer head): Smith, Jay R.; Fig. 2005Y-A.
2. FDI (heavy-duty utility funnel floor drain with 12 x 14 top, sediment bucket: Smith, Jay R. Mfg. Co.; Fig 2470C.
3. FFD (funnel floor drain with round adjustable strainer head, 4-inch diameter round funnel): Smith, Jay R.; Fig. 3510Y.

2.6 TRENCH DRAINS

A. Manufacturers:

1. ABT, Inc.
2. ACO Polymer Products
3. Smith, Jay R. Mfg. Co.
4. Zurn Industries, Inc., Specification Drainage Operation

- B. Trench Drains, General:
 1. Body Material: High Density Polyethylene (HDPE).
 2. Grate Material: Ductile iron (Zurn LD).
 3. Grate Finish: Not required.
 4. Top Loading Classification: Heavy Duty.
 5. Catch Basin: 12-inches wide x 24-inches matching trench drain with sediment bucket (Z-886).
- C. Trench Drain Schedule (Reference Manufacturer: Zurn)
 1. TD-1 Z882, Steel Frame.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install expansion joints on vertical risers, stacks, and conductors if indicated.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
 5. Locate at upper terminal of all horizontal drain lines that exceed 5 feet from drainage mains. Cleanouts not required for horizontal drain lines less than 5 feet from drainage mains, unless serving sinks or urinals.
 6. Locate above each urinal.
 7. Locate below each sink and mop sink.
 8. Locate as required by the applicable Plumbing Code.
- D. Install cleanouts with top flush with finished floor, for floor cleanouts for piping below floors.
- E. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- F. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- G. Install wall cleanouts with horizontal clearance for access:
 1. 2-inch diameter piping or less: 12-inches minimum.
 2. Piping larger than 2-inches diameter: 18-inches minimum.
- H. Install cleanouts for underfloor piping with minimum 18-inches vertical clearance and 30-inches horizontal clearance for access.

- I. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- J. Install floor drains and trench 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 and trench drains for easy access and maintenance.
 - 2. Install floor-drain and trench drains flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 3. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- K. Install traps on piping specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- L. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect drainage piping specialties to piping specified in other Division 22 Sections.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Solder joints of lead sheets 4-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors in solid coating of bituminous cement.
- D. Install flashing for piping and conduit passing through roofs with counterflashing or commercially made flashings.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.5 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 221319

SECTION 221500 – GENERAL-SERVICE COMPRESSED-AIR 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 piping and related specialties for general-service compressed-air systems operating at 200 psig and less.
- B. Related Sections include the following:
 - 1. Division 23 Section "Meters and Gages for HVAC Piping" for thermometers and pressure gages.

1.3 DEFINITIONS

- A. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 125 and 200 psig.
- B. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 125 psig and less.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipes, tubes, and fittings.
 - 2. Flexible pipe connectors.
 - 3. Safety valves.
 - 4. Pressure regulators.
 - 5. Filters.
 - 6. Automatic drain valves.
 - 7. Quick couplings.
 - 8. Hose assemblies.
 - 9. Oil/water separator.
 - 10. Air compressor.
 - 11. Air compressor accessories.

1.5 QUALITY ASSURANCE

- A. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
- B. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES, TUBES, AND FITTINGS

- A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, black or hot dip, zinc coated.
1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded. Provide Class 300 and galvanized finish if indicated.
 3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded. Provide Class 300 if indicated.
- B. Light-Wall Steel Pipe: ASTM A 135, Schedule 5, carbon steel with plain ends and zinc-plated finish.
1. Steel Pressure-Seal Fittings: UL-listed and FMG-approved, carbon-steel housing with O-ring end seals suitable for compressed-air piping and rated for 300-psig minimum working pressure. Provide FPM or NBR O-ring seals if indicated. Do not provide EPDM gasket if compressed air contains oil or oil vapor.
 - a. Manufacturer: Victaulic Corp. of America.
- C. Copper Tube: ASTM B 88, Type L, seamless, drawn-temper, water tube. Provide Type K if indicated.
1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300. Provide Class 300 if indicated.
 3. Copper Unions: ASME B16.22 or MSS SP-123.
- D. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- E. Flexible Pipe Connectors: Corrugated tubing with wire-braid covering.
1. Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Hyspan Precision Products, Inc.
 - d. Mercer Rubber Co.
 - e. Metraflex, Inc.
 - f. Midwest Control Device.

- g. Proco Products, Inc.
- 2. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: 250 psig minimum.
 - b. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - c. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

2.4 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for joining materials not in this Section.

2.5 VALVES

- A. General-Duty Valves: Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for metal ball, butterfly, check, gate, and globe general-duty valves.

2.6 SPECIALTIES

- A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.
 - 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.
 - 1. Type: Pilot operated.
- C. Air-Line Pressure Regulators: Aluminum alloy or die-cast body, diaphragm operated, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig minimum inlet pressure, unless otherwise indicated.
- D. Air-Line Lubricators: Sizes and capacities indicated; equip with drip chamber and sight dome for observing oil drop entering airstream; with oil-feed adjustment screw and quick-release collar for easy bowl removal.
- E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded.
- F. Automatic Drain Valves: Corrosion-resistant metal body and internal parts, rated for 250 psig minimum working pressure, capable of automatic discharge of collected condensate.
- G. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
 - 1. Manufacturers:
 - a. Aeroquip Corporation.
 - b. ARO
 - c. Dyna-Quip.

- d. Foster Manufacturing Co., Inc.
- e. Milton Industries, Inc.
- f. Parker Hannifin Corporation.
- g. Schrader-Bridgeport.
- h. Snap-Tite, Inc.
- i. TOMCO Products Inc.
- 2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
- 3. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
 - a. Socket End: With O-ring or gasket seal, without valve, and with serrated inlet for attaching hose.
- H. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
- I. Hose Reel Assembly: Spring loaded hose reel assembly with 50 feet of ½-inch hose.
 - 1. Manufacturers:
 - a. Speedaire (Dayton) #2CUA9 with pressure regulator and shut-off valve.
- J. Oil/Water Separator: Passive 4-stage oil/water separator to reduce oil carryover to less than 15 ppm with activated carbon final stage. Construct unit from high density polypropylene and polyethelene.
 - 1. Manufacturers:
 - a. Summit Industrial Products, "ConDePhase" Series.

2.7 IDENTIFICATION

- A. Refer to Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of piping, valves, gages, and specialties.

2.8 AIR COMPRESSOR FOR SHOP AIR SYSTEMS

- A. General: Shall be capable of operating against pressure of 690 kPa (100 psig) V-belt connected, electric motor drive, with provision for belt adjustment. Provide air compressor, air receiver, after-cooler, filter muffler and inline filter.
- B. Compressor: Reciprocating or rotary, receiver mounted. Maximum speed 1400 RPM. Lubrication system may be automatic flood system or forced feed.
- C. Air Receiver: Steel, built in accordance with applicable requirements of ASME Code for Unfired Pressure Vessels for a working pressure of 850 kPa (125 psig) and shall be stamped and certified. Equip receiver with pressure gage, lever-type safety valve and drain cock. Support receiver on saddles having bearing area extending one third shell circumference or with leg supports having equivalent bearing area.

- D. Motor and Starter: Refer to Section 22 05 13, Common Motor Requirements for Plumbing Equipment, 40 degrees C (104 degrees F) ambient temperature rise type motor, ball bearing, voltage and phase as indicated in schedule on drawings, conforming to NEMA standards, maximum speed 1800 RPM. Motor shall be of sufficient size to operate compressor without overloading. Provide each motor with automatic, fully enclosed, magnetic starter as specified in Section 26 29 11, Low-Voltage Motor Starters, controlled by a (H-O-A) switch.
- E. After-Cooled Air-Cooled: Capable of cooling the air stream within minus 4 degrees C (25 degrees F) of ambient air temperature before it enters the receiver. After-cooler shall be built in accordance with applicable requirements of ASME Code for Pressure Vessels and be provided with an automatic condensate trap.
- F. Controls: The compressor shall be equipped with an onboard controller which will control and protect the operation and condition of the air compressor. The controller shall maintain the net pressure between adjustable limits.
- G. Filtered Muffler: Filter shall be finned, dry type and be replaceable by removing cover. Muffling shall be by a series of silencer tubes.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below, unless otherwise indicated.
- B. Joining of Dissimilar Metal Piping: Use dielectric fittings. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for dielectric fitting types.
 - 1. NPS 2 and Smaller: Dielectric unions.
- C. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.
- D. Use metal general-service compressed-air piping between air compressors and air receivers. .
- E. Low-Pressure Compressed-Air Distribution Piping: Use any of the following piping materials for each size range:
 - 1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.
 - 2. NPS 2 and Smaller: Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.
 - 3. NPS 2 and Smaller: Light-wall steel pipe, steel pressure-seal fittings with EPDM O-ring seals, and pressure-sealed joints.
- F. High-Pressure Compressed-Air Distribution Piping: Use any of the following piping materials for each size range:
 - 1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

2. NPS 2 and Smaller: Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.
3. NPS 2 and Smaller: Light-wall steel pipe, steel pressure-seal fittings with EPDM O-ring seals, and pressure-sealed joints.
4. NPS 2 and Smaller: Copper tube, wrought-copper fittings, and brazed joints.

3.2 VALVE APPLICATIONS

- A. General-Duty Valves: Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for metal general-duty valves.
 1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 22 Section "General-Duty Valves for Plumbing Piping".

3.3 PIPING INSTALLATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic piping installation.
- B. Install air and drain piping with 1 percent slope downward in direction of airflow.
- C. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- D. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- E. Install flexible pipe connector on each connection to air compressors.
- F. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver; install according to Division 22 Section "Meters and Gages for Plumbing Piping."

3.4 VALVE INSTALLATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic piping and valve installation.
- B. Install metal general-duty valves according to Division 22 Section "General-Duty Valves for Plumbing Piping."
- C. Install shutoff valve at each connection to and from general-service compressed-air specialties, equipment, and accessories. Install strainer if indicated.
- D. Install check valves to maintain correct direction of fluid flow to and from compressed-air piping specialties and equipment.
- E. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- F. Install automatic drain valves on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

- G. Install safety valves where recommended by specialty manufacturers.

3.5 AIR COMPRESSOR INSTALLATION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic equipment installation.
- B. Install on spring vibration isolators and 4-inch concrete base.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for basic piping joint construction.
- B. Pressure-Seal Joints: Select correct type of O-ring seals. Make joints with fitting manufacturer's tools and according to fitting manufacturer's written instructions.
- C. Join copper tubing with brazed joints. Use silver-composition or copper-phosphorus-composition filler metal and comply with CDA's "Copper Tube Handbook," Section VII, "Brazed Joints."
- D. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support horizontal piping within 12 inches of each fitting and coupling.
- 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 Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
 2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
 3. NPS 1-1/2: 12 feet with 3/8-inch rod.
 4. NPS 2: 13 feet with 3/8-inch rod.
- G. Install supports for vertical, Schedule 40, steel piping every 15 feet.
- H. Install hangers for Schedule 5, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1/2: 72 inches with 3/8-inch rod.
 2. NPS 3/4: 84 inches with 3/8-inch rod.
 3. NPS 1: 96 inches with 3/8-inch rod.

4. NPS 1-1/4: 108 inches with 3/8-inch rod.
5. NPS 1-1/2: 10 feet with 3/8-inch rod.
6. NPS 2: 11 feet with 3/8-inch rod.

I. Install supports for vertical, Schedule 5, steel piping every 10 feet.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to specialties and equipment to allow service and maintenance.
- C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

3.9 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping systems. Refer to Division 22 Section "Identification for Plumbing Piping and Equipment" for labeling and identification materials.

3.10 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
 2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - a. Repair leaks and retest until no leaks exist.

3.11 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 221500

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following electric water heaters:
 - 1. Light-commercial electric water heaters.
 - 2. Compression tanks.
 - 3. Water heater accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For electric water heaters to include in operation and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

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. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric 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(s): From date of Substantial Completion:
 - a. Light-Commercial Electric Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Two years.
 - b. Compression Tanks: One year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

- A. Description: Comply with UL 174 for household, storage electric water heaters.
 - 1. Available Manufacturers:
 - a. American Water Heater Company.
 - b. Bradford White Corporation.
 - c. Laars Heating Systems Co.
 - d. Lochinvar Corporation.
 - e. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - f. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - g. Smith, A. O. Water Products Company.
 - h. State Industries, Inc.
 - 2. Storage-Tank Construction: Steel, vertical arrangement.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
 - e. Jacket: Steel with enameled finish.
 - f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
 - h. Temperature Control: Adjustable thermostat for each element.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction with legs for off-floor installation.

2.3 COMPRESSION TANKS

- A. 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.
 1. Manufacturers:
 - a. AMTROL Inc.
 - b. Armstrong Pumps, Inc.
 - c. Honeywell Sparco.
 - d. Smith, A. O.; Aqua-Air Div.
 - e. State Industries, Inc.
 - f. Taco, Inc.
 - g. Watts Regulator Co.
 - h. Wessels Co.
 2. Construction:
 - a. Non-ASME-code steel as scheduled with 150-psig working-pressure rating.
 - b. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - d. Air-Charging Valve: Factory installed.

2.4 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.
- C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install electric water heaters in unconditioned spaces or on concrete floors on an incompressible, insulated surface with a minimum thermal resistance of R-10.

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- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install seismic restraints for light-commercial and commercial water heaters. Anchor to substrate.
- D. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains.
- G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- H. Fill water heaters with water.
- I. Charge compression tanks with air.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to N.E.C.
- D. Connect wiring according to N.E.C.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 220800 – Commissioning of Plumbing. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 223300

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes plumbing fixtures, emergency plumbing fixtures, drinking fountains, water coolers and related components.
- B. Related Sections include the following:
 - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, wall hydrants, thermostatic water mixing valves, and specialty fixtures not in this Section.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. 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, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.4 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
 - 1. Include summary table of plumbing fixtures, in order scheduled, listing fixture identification symbol, fixture and all related trim and accessories with manufacturers and model numbers.
 - 2. Include single product data for accessories (p-traps, stops, supplies, ADA protective shielding guards, etc.) common to multiple fixtures. Identify which fixture symbols each accessory applies to. Do not duplicate product data for common accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For plumbing fixtures 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, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Regulatory Requirements: Comply with requirements of the International Building Code (IBC) and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- C. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment,"
- 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. Water Conservation: Comply with requirements of the Uniform Plumbing Code (UPC) as amended by Washington State Building Code Council (Chapter 51-47 WAC) for maximum water usage by plumbing fixtures.
- F. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers, for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.
 - 4. Vitreous-China Fixtures: ASME A112.19.2M.
 - 5. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 3. Faucet Hose: ASTM D 3901.
 - 4. Faucets: ASME A112.18.1M.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 11. Supply and Drain Fittings: ASME A112.18.1M.
- I. Comply with the following applicable standards and other requirements specified for bathtub and shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 3. Faucets: ASME A112.18.1M.
 - 4. Hand-Held Showers: ASSE 1014.
 - 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Manual-Control Antiscald Faucets: ASTM F 444.

8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings and accessories:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1M.
 - a. Stops: Chrome-plated, quarter-turn ball type; 1/2 inch nominal compression or threaded inlet, with attached lever-handle.
 - b. Supplies: Chrome-plated; flexible tubing riser with ground joint connection to fixture and wall escutcheon.
 3. Manual-Operation Flushometers: ASSE 1037.
 4. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 5. Tubular Brass Drainage Fittings and Piping: ASME A112.18.2M; 17 gauge minimum; semi-cast p-traps with cleanout, 1-1/2" minimum.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Hose-Coupling Threads: ASME B1.20.7.
 2. Hot-Water Dispensers: ASSE 1023 and UL 499.
 3. Off-Floor Fixture Supports: ASME A112.6.1M.
 4. Pipe Threads: ASME B1.20.1.
 5. Plastic Toilet Seats: ANSI Z124.5.
 6. Supply and Drain Piping Protective Shielding Guards: ICC A117.1.
 - a. Manufactured, molded anti-microbial protective pipe covers for covering hot and cold water supplies, stops, p-trap and drain piping; flush, snap-in tamper-resistant fasteners; white or gray color; ADA compliant.

1.6 COORDINATION

- A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lavatories, Water Closets, Urinals, Bathtubs:
 - a. American Standard, Inc.
 - b. Crane Plumbing
 - c. Eljer Plumbingware
 - d. Gerber Plumbing Fixtures
 - e. Kohler Co.
 - f. TOTO USA, Inc.
 - g. Zurn Industries, Inc.
 2. Stainless Steel Sinks and Service Sinks:
 - a. Elkay Mfg. Co.

- b. Just Mfg. Co.
- 3. Faucets and Shower Valves:
 - a. Central Brass
 - b. Chicago Faucet Co.
 - c. Moen Commercial
 - d. Sloan Valve Company
 - e. T & S Brass and Bronze Works, Inc.
 - f. Zurn Industries, Inc.
- 4. Flushometer Valves:
 - a. Geberit
 - b. Sloan Valve Company
 - c. TOTO USA, Inc.
 - d. Zurn Industries, Inc.
- 5. Water Closet Seats:
 - a. Bemis Mfg. Co.
 - b. Beneke Corp.
 - c. Centoco Mfg. Co.
 - d. Church Seats
 - e. Olsonite Corp.
 - f. Zurn Industries, Inc.
- 6. Drinking Fountains and Water Coolers:
 - a. Elkay Mfg. Co.
 - b. Halsey Taylor
 - c. Haws Corporation
 - d. Oasis Corporation
- 7. Service Sinks / Mop Basins:
 - a. Acorn Engineering Co.
 - b. Fiat Products
 - c. Florestone Products Co.
 - d. E.L. Mustee
 - e. Stern-Williams Co.
- 8. Fixture Supports and Carriers:
 - a. Josam Co.
 - b. MIFAB
 - c. J.R. Smith Mfg. Co.
 - d. Tyler Pipe/Wade Div.
 - e. Watts Drainage
 - f. Zurn Industries, Inc.

2.2 PLUMBING FIXTURE SCHEDULE

A. **WFA** Water Closet (Accessible): Floor-mount, bottom outlet, white vitreous china, 17" high elongated bowl, siphon action or siphon jet with white solid plastic open front seat, battery-powered, sensor operated 1.28 gpf flushometer, with chrome plated ADA compliant non-hold-open push button operator.

- 1. Flow: 1.28 gpf
- 2. Fixture and Flushometer Valve:
 - a. Zurn EcoVantage #Z5665

- B. **LWA** Lavatory (Accessible, Sensor-Operated): Wall-mount, 20"x18", white vitreous china, three (3) faucet holes with self-contained, battery powered, sensor operated, hot and cold mixing faucet with 4 inch cover plate, below deck temperature mixing valve and battery cartridge, 0.5 gpm vandal resistant aerator; 1-1/4" outlet chrome plated cast brass grid drain, 1-1/2" p-trap with cleanout and 1-1/2" x 1-1/4" reducing washer, supplies, stops and protective shielding guards on exposed water and waste piping and floor mount fixture support.
1. Fixture:
 - a. Zurn Z5360
 2. Faucet:
 - a. Zurn "AquaSense" #Z6915-F-MV
- C. **SDA** Double Compartment Sink (Accessible, with Hand Spray): Counter-mount, self-rimming, 33"x 19"x 4-1/2" deep, 18 gage (300 series) stainless steel, four faucet mounting holes 4" apart; with deck mount, two-handle mixing faucet and hand-spray, complete with quarter-turn cartridges and color-indexed wing handles, 5" high/8" reach swing spout, vandal-resistant screws and aerator; stainless steel strainer with removable stainless steel basket, 1-1/2" p-trap with cleanout, supplies and stops.
1. Fixture:
 - a. Elkay #LRAD-3319
 2. Faucet and Accessories:
 - a. Chicago Faucet #1102-VCP
 - b. Elkay #LK-35 strainers
- D. **SU** Single Compartment Sink: NSF approved, 27" x 27-1/2" x 14" deep, with one 24" x 24" x 14" deep compartments, 14 ga. (300 series) stainless steel, welded radius coved corner construction, 8" high full-length backsplash with one sets of faucet mounting holes 8" apart, stainless steel 16 gage adjustable legs with bullet-shaped feet; backsplash mounted faucet with swing-spout, handles; stainless steel strainer with brass bodies, chrome plated brass tailpiece and stainless steel lever handles, 1-1/2" p-trap with cleanout, supplies, and stops.
1. Fixture:
 - a. Elkay #WNSF8124
 2. Faucet and Accessories:
 - a. Chicago Faucet #445-DJ13-317
 - b. Elkay #25RT drains
- E. **SH** Shower Stall (Accessible): 36" wide x 36" deep x 75" high (inside dimensions), one piece, white, gel coat finish, fiberglass reinforced shower stall, 1-1/2" stainless steel grab bars, recessed soap dish, adjustable volume pressure balanced shower control valve, adjustable height hand held shower head with polished chrome finish on 24" stainless-steel rail, including vacuum breaker and metal flex hose, 1" diameter stainless steel curtain rod and escutcheons, white anti-bacterial vinyl shower curtain with hooks, integral stainless steel drain body, and vinyl flexible dam.
1. Fixture:
 - a. LASCO "FreedomLine"
 2. Shower Valve:
 - a. Zurn #Z7600-HW-MT with 2 gpm flow control.

- F. **EEW** Emergency Eye/Face Wash: Wall mounted, dual use unit, stainless steel receptor, 1-1/2" chrome plate p-trap, 92) ABS plastic spray heads with attached dust covers, self regulating flow control, stay-open chrome plate brass ball valve activated by flag handle with identification sign, wall bracket and unit dust cover. Remote mount thermostatic mixing valve with integral cold water bypass, adjustable high temperature limit stop, thermometer, integral check stop inlets, surface-mounted stainless-steel cabinet.
1. Fixture:
 - a. Guardian #G1750-BC-T
 2. Tempering Valve
 - a. Guardian #G3602
- 2.3 **TAR** Tank Type Water Closet: Floor mounted, dual flush, white vitreous china, 1.6/1.0 gallon flush, elongated bowl, pressure assisted tank with white solid plastic open front seat.
1. Fixture:
 - a. Zurn "EcoVantage" HET System Z5572-RH
- 2.4 **LCA** Lavatory Accessible, Sensor-Operated: Counter-mount, self-rimming, 19" round, white vitreous china, 4" faucet centers, lithium battery-powered, sensor-operated, deck-mount mixing faucet 0.5 gpm vandal resistant aerator, internal/external temperature control, 1-1/4" outlet chrome plated cast brass grid drain, 1-1/2" p-trap with cleanout and 1-1/2" x 1-1/4" reducing washer, supplies, stops and protective shielding guards as required.
1. Fixture:
 - a. Zurn #Z5120
 2. Faucet:
 - a. Zurn #Z6915-F-MV

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. Use manufacturer's roughing-in data if roughing-in data are not indicated.
- 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.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.

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- 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 counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- H. 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 Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves.
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install protective shielding guards on hot and cold water supplies, stops, p-trap and drain piping for fixtures designated as accessible.
- 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 traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- S. 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 Materials and Methods for Plumbing" for escutcheons.

- T. Set shower basins in leveling bed of cement grout. Refer to Division 22 Section "Common Materials and Methods for Plumbing" for grout.
- U. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect cold water supply piping to plumbed emergency plumbing fixtures without integral, water-tempering system.
- D. Connect hot and cold water supply piping to hot and cold tempering equipment. Connect tempered water piping to emergency plumbing fixtures.
- E. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.
- F. Connect drain piping from fixtures to sanitary drainage and vent piping.
- G. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- H. 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 specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- I. 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.

3.4 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.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. 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.

3.8 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

SECTION 230500 – GENERAL REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK – GENERAL

- A. This section specifies general requirements for HVAC installations and includes requirements common to more than one section of Division 23. It expands and supplements the requirements specified in sections of Division 01.
- B. Provide materials, labor, transportation, tools, permits, fees, inspections, utilities and incidentals necessary for the complete installation of HVAC work indicated and described in the Contract Documents.
- C. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified under this section of work or work specified in other sections, provide material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned or not.

1.3 SEQUENCE OF WORK

- A. Conduct work in sequence to provide least possible interference to the activities of the Owner, and to permit orderly transfer of activities and equipment to completed areas.
- B. Work shall be substantially complete by the dates listed in Division 01 Section “Summary”.

1.4 ALTERNATES

- A. Refer to Division 01 Section “Alternates” for description of alternates. Review Contract Documents for additional information.

1.5 DEFINITIONS

- A. Provide: Furnish and install complete and ready for intended use.
- B. Indicated: Indicated on drawings.
- C. Noted: Noted on Drawings or in Specifications.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

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- E. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- F. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- H. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.6 CODES AND STANDARDS

- A. Code Compliance: Comply with most current adopted edition of following:
 1. International Building Code (IBC), Standards and Amendments.
 2. International Mechanical Code (IMC), Standards and Amendments.
 3. International Fire Code (IFC), Standards and Amendments.
 4. Uniform Plumbing Code (UPC), Standards and Amendments.
 5. International Fuel Gas Code (IFGC).
 6. National Fire Protection Association (NFPA).
 7. National Electrical Code (NEC); NFPA 70.
 8. Applicable State and local codes, laws and ordinances.

1.7 SAFETY OF PERSONS AND PROPERTY

- A. Comply with applicable laws, ordinances, rules and regulations of any public authority for the safety of persons and property, including requirements of the Washington Industrial Safety and Health Administration (WISHA) and/or the Occupational Safety and Health Act (OSHA) and Division 01, General and Supplementary Conditions.

1.8 PERMITS AND FEES

- A. Obtain and pay for required permits and fees necessary to fully complete work included in the Contract Documents.
- B. Submit applications, pay application fees and obtain approval of Spokane County Air Pollution Control authority (SCAPCA) "Notice of Construction and Application for Approval" for all applicable equipment.

1.9 INTENT AND INTERPRETATION

- A. Drawings and Specifications supplement each other and any details contained in one and not the other shall be included as if contained in both. Items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation shall be included.
- B. Drawings are partly diagrammatic and do not necessarily show exact location of new piping and existing utilities, unless specifically dimensioned.

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- C. Riser and other diagrams are schematic only and do not necessarily show the physical arrangement of equipment. They shall not be used for obtaining quantities or lineal runs of piping.
- D. Grilles, fixtures or other pieces of equipment shall be centered on windows, wall spaces, or other items, unless specifically dimensioned otherwise.
- E. Location of piping and ductwork shall be checked to determine that it clears openings and structural members; that it may be properly concealed; and that it clears cabinets, lights and equipment having fixed locations.
- F. Mechanical drawings shall serve as working drawings for Division 23 work. Refer to Architectural, Structural, Civil, Landscape and Electrical drawings for additional detail affecting the installation of work. Architectural drawings shall take precedence over the Mechanical drawings if any dimensional discrepancies exist.
- G. Approximate location of each item is indicated on the drawings. These drawings are not intended to give complete and exact details in regard to location. Exact locations are to be determined by actual measurements at the building. Not all pipe and duct offsets are indicated on the drawings.

1.10 SUBMITTAL OF EQUIPMENT FOR APPROVAL

- A. Refer to Division 01 requirements for submittal definitions, requirements and procedures. Additional requirements are listed below.
- B. Shop drawings, catalog information, and material schedules shall be submitted for approval on materials and equipment prior to ordering.
- C. Submittals not meeting the following requirements will be returned for revision:
 - 1. Provide a cover page for each item or group of items (schedule group, single fixture plus trim group, etc.). Cover page shall provide a 3" x 5" space for Engineer's review stamp
 - 2. Each cover page must be clearly identified with the project name, specification number and paragraph number.
 - 3. Submittal package must be accompanied by an itemized index listing specification section, paragraph number, item and manufacturer; larger projects will be index tabbed by specification section with index for each section.

1.11 SCHEDULE OF VALUES

- A. Furnish to the Engineer, a breakdown of the Contract for work in Division 23 within 30 days of Notice to Proceed.
- B. The breakdown shall list cost for materials and labor as follows:
 - 1. Miscellaneous Overhead Expenses
 - 2. HVAC Ductwork:
 - a. Ductwork
 - b. Insulation
 - 3. HVAC Piping and Equipment:
 - a. Air Moving
 - b. Hydronic
 - c. Equipment Connections

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4. HVAC Finish
5. HVAC Instrumentation and Controls:
 - a. Submittal Engineering
 - b. Rough-in
 - c. Final
6. Testing, Adjusting and Balancing
7. Commissioning Support
8. Project Closeout:
 - a. O & M Manuals
 - b. Record Documents

1.12 GUARANTEE

- A. Guarantee satisfactory operation of material and equipment installed under Division 23. Repair or replace any defective materials, equipment, or workmanship which may show itself within one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Where more than one manufacturer is listed, provide products of only one manufacturer for each type of product.
- B. Materials used under this Contract, unless specifically noted otherwise, shall be new and of the latest and most current model line produced by the manufacturer. Outdated "new" equipment is not acceptable.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Fuel-fired equipment shall be listed by a nationally recognized testing agency.
- E. Furnish pressure vessels and relief valves in accordance with applicable Boiler and Unfired Pressure Vessel Laws.

2.2 EQUIPMENT AND MATERIAL SUBSTITUTIONS

- A. Throughout these Contract Documents, various materials, equipment, apparatus, etc., are specified by manufacturer, brand name, type or catalog number. Such designation is to establish standards of desired quality and construction and shall be the basis of the bid.
- B. Where more than one manufacturer is listed, and only one manufacturer's catalog number is indicated, that standard of quality and construction shall be maintained by materials supplied by other manufacturer(s).

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- C. Substitutions of equipment or materials shall be made only with written prior approval. Prior approval requests must be received at least ten (10) days prior to bid date unless otherwise instructed. Refer to Division 01 Section, "Substitution Procedures" for procedures in requesting substitutions. The Owner or Owner's representative shall review all substitution requests for final approval.
- D. Substitution request must include manufacturer, specific model number, special features, physical dimensions, and capacities of proposed equipment. Verify requirements before submitting for approval.
- E. The Contractor shall bear full responsibility for substituted equipment and materials, including, but not limited to:
 - 1. Costs.
 - 2. Available space requirements
 - 3. Effect on other trades
 - 4. Changes in electrical requirements
 - 5. Changes in structural requirements.

PART 3 - EXECUTION

3.1 SUSTAINABILITY

- A. Comply with requirements of Division 01 Section "Sustainable Design Requirements".

3.2 COMMISSIONING

- A. Comply with requirements of Division 01 Section "General Commissioning Requirements" and requirements of individual Division 23 Sections for HVAC Commissioning.

3.3 COORDINATION

- A. Refer to Division 01 Section "Project Management And Coordination".
- B. Coordinate available space for equipment and systems with other trades. Refer to Architectural, Structural and Electrical Drawings for additional building details necessary for coordination.
- C. Cutting, patching, wiring, finishing or any other work required for relocation of work installed due to interferences between work of the various trades will be at no additional cost to the Owner.

3.4 MANUFACTURER'S INSTRUCTIONS

- A. Furnish proper equipment and/or materials required for installation as intended by the manufacturer, for all work described under Division 23. If needed for proper installation or operation, request advice and supervisory assistance from the representative of the specific manufacturer. Manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufactured materials or equipment, unless otherwise indicated. Promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's instructions before proceeding with the work.

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3.5 EXAMINATION OF SITE

- A. Visit site of proposed work and become familiar with conditions affecting work. Verify measurements at the building before beginning work.

3.6 EXISTING UTILITIES AND PIPING

- A. Locations of existing concealed lines and connection points have been indicated as closely as possible from available information. Assume that such connection points are within a 10-foot (10') radius of indicated locations. Where connection points are not within this radius, contact the Architect for a decision before proceeding.

3.7 LAYING OUT WORK

- A. Locations of equipment and devices, as shown on the drawings, are approximate unless dimensioned. Exact locations of such items shall be determined from the Construction Drawings. Verify physical dimensions of each item of mechanical equipment, ductwork system and piping system, to fit available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordinate equipment to available space and access routes through construction. Offsets or transitions in ductwork or piping systems required for proper system operation and/or installation, whether indicated on drawings or not, shall be provided at no additional cost to Owner.

3.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- C. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

3.9 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate location of concealed equipment and devices requiring access with location of access panels and doors. Allow ample space for removal of parts that require replacement or servicing.

3.10 TEMPORARY USE OF NEW EQUIPMENT

- A. New equipment shall not be used for temporary heating, cooling or ventilation unless authorized in writing by the Owner.

END OF SECTION 230500

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SECTION 230505 – PROJECT CLOSEOUT FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 01 Section “Closeout Procedures”.

1.2 SCOPE OF WORK - GENERAL

- A. This section specifies procedural requirements for HVAC installations project closeout, including but not limited to:
 - 1. Project Record Document submittal.
 - 2. Operation and Maintenance Manual submittal.
 - 3. Operation and Maintenance Instruction and Training.
 - 4. Mechanical Equipment and Systems Start-Up.
 - 5. Lubrication.
 - 6. Final Cleaning.

1.3 PROJECT RECORD DOCUMENTS

- A. Record differences between mechanical work as installed and as shown in Contract Drawings on a set of prints of mechanical drawings furnished by Architect. Return these prints to Architect at completion of project. Notations made on drawings shall be neat and legible. Comply with Division 01 Section requirements.
- B. Mark drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers, and other control devices, filters, motors and similar items requiring periodic maintenance; actual equipment locations; concealed equipment and control devices; mains and branches of piping systems, with valves and control devices located and numbered; actual inverts and locations of underground piping.
- C. Revise equipment and fixture schedules on the Drawings to indicate actual installed manufacturer and model numbers.
- D. Mark specifications to indicate change orders; actual equipment and materials used.
- E. The Commissioning Authority may review record drawings once monthly for completeness.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Prepare and submit Operation and Maintenance (O&M) Manuals for mechanical systems provided. Comply with Division 01 Section requirements.

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B. Manual binder shall have permanent lettering of a contrasting color. Information to be included on the binder is as follows:

1. The front cover shall be lettered as follows:

HVAC
OPERATION AND MAINTENANCE
MANUAL
(PROJECT NAME)
(CITY AND STATE)
(YEAR)

OWNER:	(NAME)
ARCHITECT:	(NAME)
MECHANICAL ENGINEER:	L&S ENGINEERING ASSOCIATES, INC.
GENERAL CONTRACTOR:	(NAME)
MECHANICAL CONTRACTOR:	(NAME)

2. The spine shall be lettered as follows:

HVAC O & M MANUAL (Year)
(Project Name)

- C. Provide master index at beginning of Manual showing sections and items included. Use plastic tab indexes for sections of Manual.
- D. Cover section: List name, address, and phone number of Project Architect, General Contractor, Mechanical Engineer, Mechanical Contractor and all Mechanical Sub-Contractors. Provide a list of equipment suppliers with address and phone number.
- E. Provide a separate section for each Section of the Specifications. Provide index for each section listing equipment included. Include all items specified.
- F. Include descriptive literature (manufacturer's catalog data) of each manufactured item. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined. Data sheets shall be originals or clean copies of originals. Copies of faxes are not acceptable. Include copies of approved submittals or shop drawings for all items requiring submittal.

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- G. One draft copy of the manual shall be submitted to both the Engineer and Commissioning Authority for review, comment and approval, as applicable, at least 15 days prior to substantial completion or training, whichever is first. After approval, submit 3 copies of manual to Architect for approval unless otherwise directed by Division 01 Section requirements. Information to be included in manual:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping shut-down, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
 5. Schematic control diagrams for each automatic control system. Mark correct operating setting for each control instrument on these diagrams.
 6. Valve schedule indicating the valve symbol (tag number), valve location by room number and description, valve purpose and system served, and valve size. Provide 1 corresponding set of full size mechanical prints showing these valve locations for cross-reference. A second complete set of valve schedules (8 1/2 in. x 11 in.) encased in clear plastic laminate and fitted in an aluminum holding frame shall be furnished to the Owner.
 7. Testing, Adjusting and Balancing Report.
 8. Test records and certifications.
 9. Equipment start-up reports.
 10. Warranty information and letters of guarantee.
 11. Instruction period checklist for each equipment item.
- H. Complete O&M Manual shall be available for use by Owner's representatives during instruction and training sessions.

1.5 OPERATION AND MAINTENANCE INSTRUCTION AND TRAINING

- A. Instruct Owner's Representative(s) in the Operation and Maintenance procedures described in Operation and Maintenance Manual. Comply with Division 01 Section requirements.
- B. Enlist services of qualified personnel, including each sub-trade and factory trained specialists for each major piece of equipment, to attend training sessions and provide operation and maintenance instructions.
- C. The Commissioning Authority is responsible for preparing the final list of equipment requiring training for the Owner's personnel. Additional training sessions may be required by the owner based on staffing requirements at the campus. Training sessions shall be scheduled with the Commissioning Authority at least two weeks in advance. Prior to scheduling, the contractor must submit a lesson plan to the Commissioning Authority with topics to be covered during training, a list of persons recommended to attend, and any documents or other audio visual aids that will be used in the training sessions.

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- D. Sign in sheets shall be used for all attendees, including manufacturer's, vendor's and contractor's personnel. Obtain written sign off on all training sessions from the Commissioning Authority and Owner.
- E. Allow a minimum of four hours instructional time per equipment category. Refer to individual Division 23 sections for additional instruction/training requirements."
- F. Training sessions on key pieces of equipment or systems may be required by the Owner to be video recorded. Any such recordings should be produced on DVD or VHS video format. Coordinate requirements with the Commissioning Authority.
- G. All mechanical systems shall be properly functioning prior to instruction period.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 MECHANICAL EQUIPMENT AND SYSTEMS START-UP

- A. Provide the services of a service representative to test and inspect unit installation, provide start-up service and demonstrate and train Owner's maintenance personnel.
- B. Include certification of representative status as part of equipment submittal from manufacturer. Include copies of any installation and start-up instructions, manufacturer's checklists and other forms used in start-up as part of the equipment submittal. These instructions and checklists will be utilized by the Commissioning Authority in developing start-up and functional performance testing procedures in accordance with Division 01 Section "General Commissioning Requirements", and Division 23 Section "Commissioning of HVAC". Upon successful completion of equipment start-up, a copy of all manufacturer's forms will be given to the Commissioning Authority for enclosure in the records.
- C. Include written start-up reports with test data for equipment in Operation and Maintenance Manual.
- D. All construction debris, including electrical wiring debris shall be removed from units prior to equipment start up. Areas surrounding and served by equipment being started must be free of construction debris, sheetrock dust and any materials that may adversely affect the equipment.

3.2 LUBRICATION

- A. Lubricate all pieces of equipment in accordance with Manufacturer's written instructions prior to project closeout. Include a listing of all equipment with the date of final lubrication in Operation and Maintenance manual.

3.3 FINAL CLEANING

- A. Refer to Division 01 general requirements for final cleaning.
- B. At time of final cleanup, clean all fixtures and equipment and leave in condition for use intended. Vacuum cabinet interiors of control panels, air handling units, etc. to remove all construction debris including electrical wiring debris.

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3.4 COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Division 23 Section "Commissioning of HVAC". The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230505

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

SECTION 230509 – COMMON MATERIALS AND METHODS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to HVAC systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting.
 - 10. Supports and anchorages.
 - 11. Access doors.
 - 12. Through-penetration fire stop systems.
 - 13. Excavation and backfill.
 - 14. Cutting and patching.

1.3 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, 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 duct shafts.
- 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. PVC: Polyvinyl chloride plastic.

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3. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
 5. Access Doors.
 6. Through-Penetration Fire Stop Systems.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

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- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers listed.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BAg1, 15% silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 3. PVC to ABS Piping Transition: ASTM D 3138.

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2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

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2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: 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.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 22 gage 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. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 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, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With hinge, set screw or spring clips, and chrome-plated finish.

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- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 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.

2.10 ACCESS DOORS

- A. Description: Access doors, non-rated and fire-rated for ceiling and wall surfaces.
- B. Related sections include the following:
 - 1. Division 23 Section, "Air Duct Accessories" for duct-mounting access doors in HVAC systems.
- C. Manufacturers:
 - 1. Acudor Products, Inc.
 - 2. Cesco Products.
 - 3. Elmdor/Stoneman; Div. Of Acorn Engineering Co.
 - 4. Karp Associates.
 - 5. Milcor .
- D. Flush, Insulated, Fire-Rated Access Doors and Trimless Frames: Fabricated from steel sheet.
 - 1. Locations: Gypsum board wall and ceiling surfaces.
 - 2. Fire-Resistance Rating: One and a half hours, "B" label.
 - 3. Temperature Rise Rating; 250 degrees at the end of 30 minutes.
 - 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
 - 5. Frame: Minimum 0.060 inch thick sheet metal with drywall bead.
 - 6. Hinges: Continuous piano hinge.
 - 7. Automatic Closer: Spring type.
 - 8. Latch: Self-latching bolt with interior release.
- E. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
 - 1. Locations: Gypsum board wall and ceiling surfaces.
 - 2. Door: Minimum 0.060 inch thick sheet metal, set flush with exposed face flange of frames.
 - 3. Frame: Minimum 0.060 inch thick sheet metal with 1 inch wide surface-mounted trim.
 - 4. Hinges: Continuous piano hinge.
 - 5. Latch: Screwdriver operated cam latch.
- F. Flush Access Doors and Trimless Frames: Fabricated from steel sheet.
 - 1. Locations: Gypsum board wall and ceiling surfaces.
 - 2. Door: Minimum 0.060 inch thick sheet metal, set flush with surrounding finish surfaces.
 - 3. Frame: Minimum 0.060 inch thick sheet metal with drywall bead.

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4. Hinges: Continuous piano hinge.
5. Latch: Screwdriver operated cam latch.

2.11 THROUGH-PENETRATION FIRE STOP SYSTEMS

- A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
 1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
 2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
 3. Fire-resistance-rated floor assemblies.
 4. Fire-resistance-rated roof assemblies.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

Penetrations located outside wall cavities.

 1. Penetrations located outside fire-resistive shaft enclosures.
 2. Penetrations located in construction containing fire-protection-rated openings.
 3. Penetrating items larger than 4-inch diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
- D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
- E. Related sections include the following:
 1. Division 07 Section "Firestopping".
 2. Division 23 Sections specifying duct and piping penetrations.
- F. Submittals:
 1. Product Data: For each type of through-penetration firestop system product indicated.
 2. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
 3. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
- G. Manufacturers:
 1. Bio-Fireshield
 2. Firestop Systems Inc.
 3. Hilti Construction Chemicals, Inc.

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4. International Protective Coatings Corp.
5. RectorSeal Corporation .
6. 3M Fire Protection Products.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved.
- 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. Do not run piping directly over electrical panels or switchgear.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Cap or seal temporary openings in piping during construction. Remove caps or seals for final connections.
- M. Select system components with pressure rating equal to or greater than system operating pressure.
- N. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

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- e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
- O. Sleeves are not required for core-drilled holes.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions where specifically indicated and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. 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.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- 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. 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.
- T. Fire-Barrier Penetrations:
- 1. Use metallic piping only for fire-barrier penetrations. Transition from system pipe material to penetration material as required.

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2. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

- U. Verify final equipment locations for roughing-in.
- V. 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 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using AWS A5.8, BAg1, 15% silver alloy brazing filler metal.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 4. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

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3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each threaded valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical 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. Painting of mechanical systems, equipment, and components is specified in Division 09 Section, "Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

- A. Mix and install grout for mechanical 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.

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- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.8 ACCESS DOORS

- A. Provide access doors wherever required to service valves, dampers, fire dampers, motor or any other items of equipment where concealed, unless specifically indicated on the drawings to be furnished under other Section(s).
- B. Size and locate access doors for service and maintenance of equipment items to allow adequate access for required service.
- C. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.
- D. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- E. Adjust doors and hardware after installation for proper operation.
- F. Label access doors.

3.9 THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Examination:
 - 1. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Preparation:
 - 1. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer:
 - 2. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Through-Penetration Firestop System Installation:
 - 1. General: Install through-penetration firestop systems in accordance with manufacturer's written installation instructions and published drawings for products and applications indicated.
 - 2. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

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D. Cleaning and Protection:

1. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
2. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

3.10 EXCAVATION AND BACKFILL

- A. Provide necessary excavation, shoring, and backfilling required for proper installation of mechanical work.
- B. During excavation, stockpile material satisfactory for backfilling in an orderly manner at a distance from the banks of the trench equal to half the depth of the excavation, but in no instance closer than 2 feet. Remove excavated material not required or not satisfactory for backfill from the site and dispose of properly. Grading shall be done as necessary to prevent surface water from flowing into the excavation. Remove accumulated water to maintain stability of the bottom and sides of excavation.
- C. Excavate trenches to depth required to establish indicated slope and invert elevations and to support bottom of piping or conduit on undisturbed soil. Trenches shall be of uniform width, sufficient to provide ample working room and a minimum of 12 inches of clearance on both sides of pipe or conduit.
- D. Grade bottoms of trenches to provide uniform bearing and support for bottom quadrant of each section of pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing.
- E. Remove stones of 2 inches or greater in any dimension, or as recommended by pipe manufacturer, whichever is smaller, to avoid point bearing. Where unyielding material is encountered in the bottom of trench, remove such material 6 inches below required grade and replaced with materials described below for bedding.
- F. Bedding and initial backfill material: Clean, sand-gravel mixture free from organic matter and conforming to the following gradation when tested in accordance with ASTM D 2940.

U.S. Standard Sieve Size	Percent Passing
1 inch	100
No. 200	0-10

- G. Backfill: Satisfactory soil materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP, free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

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- H. Place bedding and initial backfill material to a depth of 6 inches over the top of piping. Bring material up evenly on both sides of pipe for full length of pipe.
- I. Backfill to the required grade in layers not exceeding 4 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines otherwise specified. Compact top 12 inches below subgrade and each layer of backfill at 95 percent maximum dry density (ASTM D 1557) under structures, building slabs, steps, pavements and walkways. Compact the top 6 inches below subgrade and each layer of backfill at 90 percent maximum dry density (ASTM D 1557) under lawn or unpaved areas.
- J. Do not cover underground lines until installation has been approved by the inspector having jurisdiction and Owner's Representative.
- K. Cut trenches within 5 feet of footings or under footings only after approval of the Architect.
- L. Provide bracing and shoring where depth of excavation or character of ground render it necessary for personnel protection. Comply with local and state safety laws and regulations.
- M. Remove bracing and shoring materials before backfilling except where necessary to insure against caving.
- N. Provide securely constructed barricades around excavation.
- O. Exercise extreme care while excavating in the area of utilities, carefully check for location of possible utilities, whether shown on the drawings or not, and establish location of cutoff valves for ready shut-off of service in case of emergency. Assume complete responsibility for all damage to any utilities caused in excavating as well as damage to personnel and property caused by said damaged utilities whether shown on drawings or not.

3.11 CUTTING AND PATCHING

- A. Comply with Division 01 Section, "Execution" for general requirements for cutting and patching.
- B. Cutting shall be performed with masonry saws, core drills or similar equipment to provide neat and uniform openings.
- C. Patching shall match adjacent surfaces in materials and finish. Do not endanger or damage installed work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations. will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover work to provide for installation of ill-timed work.

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2. Remove and replace defective work.
 3. Remove and replace work not conforming to requirements of the Contract Documents.
 4. Remove samples of installed work as specified for testing.
 5. Install equipment and materials in existing structures.
 6. Upon written instructions from the Architect, uncover and restore work to provide for observation of concealed work.
- G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by new work.
- H. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- I. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.12 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230509

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SECTION 230511 – ELECTRICAL PROVISIONS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 23 Section “Common Motor Requirements for HVAC Equipment”.

1.2 SUMMARY

- A. This section specifies basic requirements for field-installed accessory electrical components specified as a part of packaged mechanical equipment. These components include, but are not limited to controllers, motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment, but not factory-installed.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are specified within the individual equipment specifications or scheduled on the drawings.
- C. Make all required electrical connections from mechanical equipment to accessory electrical components furnished by manufacturer as a part of equipment but intended to be field-installed, including pushbuttons, pilot lights, interlocks, speed controllers, and similar devices.
- D. Provide all required electrical connections of field-mounted float control switches, flow control switches, and similar mechanical/electrical devices provided for pumps and similar mechanical equipment.
- E. Provide interconnecting wiring between mechanical equipment shipped in multiple parts and designed by the manufacturer to have field-installed interconnecting wiring.
- F. All electrical work shall comply with applicable requirements of Division 26.

1.3 REFERENCES

- A. NEMA Standard ICS 2: Industrial Control Devices, Controllers and Assemblies.
- B. NEMA Standard 250: Enclosures for Electrical Equipment.
- C. NEMA Standard KS 1: Enclosed Switches. Comply with National Electrical Code (NFPA 70).

1.4 SUBMITTALS

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves as required by the individual equipment specification sections.

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1.5 QUALITY ASSURANCE

- A. All electrical components and materials shall be labeled by an approved testing agency (UL, ETL, CSA, etc.).

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with applicable requirements of Division 26 and NFPA 70 (National Electrical Code).
- B. Install equipment and wiring per manufacturer's instructions.

3.2 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230511

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SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes basic requirements for factory-installed motors.
- B. Related Sections include the following:
 - 1. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
 - 2. Division 23 Section, "Electrical Provisions for HVAC Equipment".

1.3 DEFINITIONS

- A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

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. Comply with NFPA 70, National Electrical Code.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

- A. Motor requirements apply to all motors except as follows:
 - 1. Different ratings, performance, or characteristics for a motor are specified in another Section.
 - 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.2 MOTOR CHARACTERISTICS

- A. Motors 3/4 HP and Larger: Three phase.
- B. Motors Smaller Than 3/4 HP: Single phase.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

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- E. Service Factor: 1.15 for open drip-proof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Enclosure: Open drip-proof.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Minimum Nominal Full Load Efficiency:

	MINIMUM NOMINAL FULL-LOAD EFFICIENCIES (%)					
	OPEN MOTORS			CLOSED MOTORS		
Number of Poles	2	4	6	2	4	6
Synchronous Speed (RPM)	3600	1800	1200	3600	1800	1200
Motor HP	Efficiency	Efficiency	Efficiency	Efficiency	Efficiency	Efficiency
1.0	77.0	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2.0	85.5	86.5	87.5	85.5	86.5	88.5
3.0	85.5	89.5	88.5	86.5	89.5	89.5
5.0	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10.0	89.5	91.7	91.7	90.2	91.7	91.0
15.0	90.2	93.0	91.7	91.0	92.4	91.7
20.0	91.0	93.0	92.4	91.0	93.0	91.7

- C. Stator: Copper windings, unless otherwise indicated.
 - 1. Multi-speed motors shall have separate winding for each speed.
- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or G.
 - 2. Motors Smaller Than 15 > HP: Manufacturer's standard starting characteristic.

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- I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Manufacturer's standard.
- 2.4 SINGLE-PHASE MOTORS
- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
 - B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
 - C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
 - D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated-sleeve type for other single-phase motors.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.
 - 2. Verify bearing lubrication.
 - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - 4. Test interlocks and control and safety features for proper operation.
 - 5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

3.2 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.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

3.3 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230513

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SECTION 230519 – METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following meters and gages for HVAC piping:
 - 1. Thermometers.
 - 2. Gages.
 - 3. Test plugs.
- B. Related Sections include the following:
 - 1. Division 23 Section “Facility Natural-Gas Piping” for natural gas service meters.
 - 2. Division 23 Section “Hydronic Piping” for calibrated balancing valves, venturi and wafer-orifice flowmeters.
 - 3. Division 23 Section “Instrumentation and Control for HVAC” for electronic flow meters.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. Marsh Bellofram.
 - 2. MILJOCO Corporation.
 - 3. Tel-Tru.
 - 4. Trerice, H. O. Co.
 - 5. Weiss Instruments, Inc.
 - 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 7. Winters Instruments.
- B. Case: Plastic or die-cast aluminum, 9 inches long.

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- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Metal, for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
 - 1. Material: Brass, for use in copper piping.
 - 2. Material: Steel, for use in steel piping.
 - 3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
 - 4. Insertion Length: To extend to center of pipe, minimum insertion length 2-1/2 inches.

2.4 PRESSURE GAGES

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 3. Marsh Bellofram.
 - 4. MILJOCO Corporation.
 - 5. Tel-Tru.
 - 6. Trerice, H. O. Co.
 - 7. Weiss Instruments, Inc.
 - 8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 9. WIKA Instrument Corporation.
 - 10. Winters Instruments.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Dry type, cast aluminum, 4-1/2-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red or other dark-color metal.
 - 7. Window: Glass.

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8. Ring: Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

A. Manufacturers:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. Peterson Equipment Co., Inc.
4. Sisco Manufacturing Co.
5. Trerice, H. O. Co.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: Two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be chlorosulfonated synthetic rubber.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit containing one pressure gage and adaptor, two thermometers, and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:

1. Inlet and outlet of each hydronic boiler and chiller.
2. Where indicated on Drawings.

B. Provide the following temperature ranges for thermometers:

1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Chilled- and condenser-water inlets and outlets of chillers.
3. Suction and discharge of each hydronic pump.

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3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending a minimum of 2 inches into fluid or to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.
- E. Provide test plugs at the following locations whether indicated on plans or not:
 - 1. Adjacent to all gauges, temperature or pressure sensors, and thermometers. If instruments/ sensors are grouped, one test plug will suffice if provided in a common location.
 - 2. Adjacent to the supply and discharge of all pumps and manual flow control devices.
 - 3. At the inlet and outlet sides of all hydronic coils. Test plugs supplied with combination-duty type valves or as an integral component are acceptable substitutes for applications.
 - 4. Adjacent to each temperature control sensor thermowell.
- F. Restricting devices (pressure reducing valves, etc.) shall not be placed between test plugs and device being tested.
- G. Install flow indicators, in accessible positions for easy viewing, in piping systems.

3.4 CONNECTIONS

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

3.5 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230519

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SECTION 230523 – GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following general-duty valves for HVAC piping:
 - 1. Ball valves.
 - 2. Butterfly valves.
 - 3. Swing check valves.
 - 4. Spring-loaded, lift-disc check valves.
 - 5. Gate valves.
- B. Related Sections include the following:
 - 1. Division 22 Section "Instrumentation and Control for HVAC" for control valves and actuators.
 - 2. Division 23 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. WOG: Non-shock Water-Oil-Gas working pressure rating, psig.
 - 2. SWP: Steam working pressure rating, psig.
 - 3. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 4. PTFE: Polytetrafluoroethylene plastic.
 - 5. TFE: Tetrafluoroethylene plastic.
 - 6. NRS: Non-rising stem.
 - 7. RS: Rising stem.
 - 8. OS&Y: Outside stem and yoke.
 - 9. MSS: Manufacturer's Standardization Society of the Valve and Fittings Industry.
 - 10. PPS: Polyphenylene sulfide.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances.
- B. Maintenance Data: For each type of valve indicated to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10.

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- C. ASME Compliance for Bronze Valves: ASME B16.24.
- D. MSS Compliance:
 - 1. SP-67: Butterfly Valves.
 - 2. SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 3. SP-71: Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - 4. SP-80: Bronze Gate, Globe, Angle and Check Valves.
 - 5. SP-85: Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
 - 6. SP-110: Ball Valves, Threaded and Solder Joint Ends.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Anvil International, "Gruvlok" Series.
 - 2. Conbraco/Apollo Industries
 - 3. Hammond Valve
 - 4. Milwaukee Valve Company
 - 5. NIBCO, Inc.
 - 6. Stockham
 - 7. Victaulic Company of America

2.2 VALVES, GENERAL

- A. Valve Type/Manufacturer: Valves of same type shall be of same manufacturer.
- B. Refer to Part 3 "Valve Applications" Article for applications of valves.
- C. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- D. Brass Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- E. Iron Valves: NPS 2-1/2 and larger with flanged ends or grooved ends, unless otherwise indicated.
- F. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- H. Valve Actuators:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller.
- I. Extended Valve Stems: On insulated valves.
- J. Valve Flanges: ASME B16.10 for iron valves; ASME B16.24 for bronze valves.
- K. Valve Grooved Ends: ASME/AWWA C606.

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2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, General: MSS SP-110.
- B. Two-Piece Ball Valves: Bronze body with full port, hard chrome-plated solid brass or bronze ball, reinforced TFE seats and PTFE packing, adjustable packing nut, blowout-proof brass stem, threaded ends; 150 SWP/600 WOG.
 - 1. Milwaukee BA-400, or equal.

2.4 IRON BODY BUTTERFLY VALVES

- A. Iron Body Butterfly Valves, General: MSS SP-67, bubble tight seal. Select lug (flanged) body type where dead-end service is required to remove downstream piping for equipment removal or maintenance. Select wafer (flangeless) body type for other applications.
- B. Butterfly Valves: Cast iron body, aluminum bronze disc, 416 stainless steel two-piece stem design, field replaceable hard phenolic backed EPDM liner, non-metallic stem journal, blowout-proof stem, extended neck for 2 inch insulation, 10-position lever-lock handle with memory position plate for sizes NPS 6 and Smaller, lug or wafer body type; 200 WOG.
 - 1. Milwaukee CW/CL or MW/ML Series, or equal.
- C. Grooved-End, Butterfly Valves: ASTM A 536 ductile iron body, electroless nickel, aluminum bronze, or stainless steel offset disc, EPDM seat with full continuous contact, EPDM stem seals, 10-position lever-lock handle or gear operator; 300 WOG.
 - 1. Anvil "Gruvlok" 7700 Series.
 - 2. Victaulic Vic-300 Mater-Seal Series.

2.5 GROOVED NON-FERROUS ALLOY BUTTERFLY VALVES

- A. Grooved-End, Non-Ferrous Butterfly Valve: 300 CWP rating, cast bronze body, elastomer encapsulated ductile iron disc, with grooved ends manufactured to copper-tube dimensions.
 - 1. Anvil "Gruvlok" 7721 Series.
 - 2. Victaulic Series 608.

2.6 BRONZE CHECK VALVES

- A. Bronze Check Valves, General: MSS SP-80.
- B. Horizontal Swing Check Valves: Bronze body, threaded cap, bronze or TFE disc, integral bronze seats, threaded ends; 125 SWP/200 WOG.
 - 1. Milwaukee 509, or equal.
- C. Horizontal Swing Check Valves: Bronze body, threaded cap, TFE disc, integral bronze seats, threaded ends; 150 SWP/300 WOG.
 - 1. Milwaukee 510-T, or equal.
- D. Horizontal Swing Check Valves: "Y" pattern swing, bronze body, threaded cap, regrindable bronze disc, stainless steel hinge pins, integral bronze seats, threaded ends; 200 SWP.
 - 1. Milwaukee 508, or equal.

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2.7 IRON BODY SWING CHECK VALVES

- A. Iron Body Swing Check Valves, General: MSS SP-71.
- B. Horizontal Swing Check Valves: Cast iron body, bronze trim, bolted bonnet, bronze or cast iron disc, bronze seat ring, flanged ends; 125 SWP/200 WOG.
 - 1. Milwaukee F2974, or equal.

2.8 SPRING-LOADED, LIFT-DISC CHECK VALVES

- A. Bronze Spring-Loaded Lift-Disc Check Valves: Bronze body, non-slam, in-line spring lift check, TFE disc, bronze or TFE seat, bronze or stainless steel spring, threaded ends; 250 WOG.
 - 1. Milwaukee 548T, or equal.
- B. Iron Body Compact-Wafer, Lift-Disc Check Valves: Wafer (flangeless) style, non-slam, cast iron body, bronze trim and disc, center guided, stainless steel springs and screws; 125 SWP/200 WOG.
 - 1. Milwaukee 1400, or equal.
- C. Ductile Iron Spring-Assisted, Check Valves: Grooved style, non-slam, ductile iron body, aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft; 300 CWP.
 - 1. Victaulic Series 716.

2.9 BRONZE GATE VALVES

- A. Bronze Gate Valves, General: MSS SP-80.
- B. Gate Valves: Bronze body, union bonnet, rising stem, malleable iron handwheel, solid bronze wedge, non-asbestos packing, gland follower, threaded ends; 150 SWP/300 WOG.
 - 1. Milwaukee 1151, or equal.

2.10 CAST-IRON GATE VALVES

- A. Cast-Iron Gate Valves, General: MSS SP-70.
- B. Gate Valves: Cast iron body, bolted bonnet, OS&Y, rising stem, bronze trim, cast iron handwheel, solid wedge, non-asbestos packing, gland follower, flanged ends; 125 SWP/200 WOG.
 - 1. Milwaukee F2885, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

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- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine grooved ends for conditions that might cause leakage. Ends should be free from indentations or projections in the area from valve end to groove.
- F. 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.
- G. Do not attempt to repair defective valves; replace with new valves.

3.2 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. Gate valves to be used only where specifically indicated.
 - 2. Throttling Service: Ball valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified SWP or WOG ratings are not available, the same types of valves with higher SWP or WOG ratings may be substituted.
- C. HOT WATER HEATING PIPING: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: 600 WOG, bronze body and ball.
 - 2. Butterfly Valves, NPS 2-1/2 to NPS 12: 200 WOG, iron body.
 - 3. Butterfly Valves, NPS 2-1/2 to NPS 12: 300 WOG, ductile iron body.
 - 4. Swing Check Valves, NPS 2 and Smaller: 150 SWP/300 WOG, bronze body.
 - 5. Swing Check Valves, NPS 2-1/2 and Larger: 125 SWP/200 WOG, bronze trim, iron body.
 - 6. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: 250 WOG, bronze body.
 - 7. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: 125 SWP/200 WOG, wafer style, bronze trim, iron body.
- D. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
 - 2. For Copper Tubing, NPS 2-1/2 and NPS 3: Threaded, grooved or flanged ends.
 - 3. For Copper Tubing NPS 4 and Larger: Flanged or grooved ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 and Larger: Flanged or grooved ends.
 - 6. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved.

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3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Compact-Wafer Lift-Disc Check Valves: In horizontal or vertical position, between flanges.
- F. Install unions adjacent to each threaded end valve and at final connection to each piece of equipment.
- G. Install flanges adjacent to flanged valves and at final connections to each piece of equipment.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Materials and Methods for HVAC" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. . All grooved couplings, fittings, valves, and specialties shall be of the same manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. 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 inspect the product installation. Contractor shall remove and replace any improperly installed products.

3.5 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230523

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SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes hangers and supports for HVAC piping and equipment.
- B. Related Sections include the following:
 - 1. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation and seismic restraint devices.
 - 2. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pipe Hangers:
 - a. Anvil International, Inc.
 - b. Globe Pipe Hanger Products, Inc.
 - c. Erico/Michigan Hanger Co., Inc.
 - d. PHD Manufacturing, Inc.
 - e. Thomas & Betts
 - f. Tolco Inc.
 - g. Unistrut Corp.
 - 2. Channel Support Systems:
 - a. Erico/Michigan Hanger Co., Inc.; O-Strut Div.
 - b. Thomas & Betts Corp.
 - c. Tolco Inc.
 - d. Unistrut Corp.
 - 3. Thermal-Hanger Shield Inserts:
 - a. Erico/Michigan Hanger Co., Inc.

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- b. PHS Industries, Inc.
- c. Pipe Shields, Inc.
- d. Rilco Manufacturing Co., Inc.
- e. Value Engineered Products, Inc.
- 4. Pipe Stands
 - a. Erico/Michigan Hanger Co., Inc.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.

2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 - 1. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
 - 2. Nonmetallic Coatings: Plastic coating, jacket or liner.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
 - 1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 - 2. Nonmetallic Coatings: Plastic coating, jacket or liner.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
 - 1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 - 2. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
 - 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 4. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 - 5. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-wedge type zinc-coated steel, for use in hardened Portland cement with pull-out, tension and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

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

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- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 3. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 4. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
 - 6. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

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8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units. Make allowance for pipe insulation as required.
- E. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- G. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9.

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2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: 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. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting.
- B. Galvanized Surfaces: Clean welds, bolted connections and abraded area and apply galvanizing repair paint.

3.7 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230529

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SECTION 230548 – VIBRATION & SEISMIC CONTROLS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23 Section “Hydronic Piping” for flexible pump connectors and hose kits.
 - 2. Division 23 Section “Air Duct Accessories” for flexible connectors.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Elastomeric isolation pads and mounts.
 - 2. Freestanding and restrained spring isolators.
 - 3. Elastomeric hangers.
 - 4. Spring hangers.
 - 5. Restraining cables.

1.3 PERFORMANCE REQUIREMENTS

- A. Selection and installation of seismic restraint devices shall be in accordance with IBC 1621 and ASCE (American Society of Civil Engineers) Standard 7-02, “Minimum Design Loads for Buildings and Other Structures”, Section 9.6.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 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.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - 2. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include base weights, equipment static loads, and cantilever loads.

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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. 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).

C. Qualification Data: For Professional Engineer.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base.
- B. Coordinate installation of equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION SCHEDULE

- A. Provide the following vibration isolators and bases for mechanical equipment and systems:
 1. Equipment: Fan-Coil Units, up to 2000 CFM (base mounted).
 - a. Base: Unit integral support base.
 - b. Isolators: Neoprene isolation pads, type 1.
 - c. Minimum Deflection (in.): 0.25-inch.
 2. Equipment: Air-Cooled Condensing Units.
 - a. Base: Unit integral support base.
 - b. Isolators: Neoprene isolation pads, Type 1.
 - c. Minimum Deflection (in.): 0.25-inch.
 3. Equipment: Modular Indoor Air-Handling Units with Internal Fan Isolation.
 - a. Base: None required. Unit integral support base acceptable.
 - b. Isolators: Neoprene isolation pads, Type 1.
 - c. Minimum Deflection (in.): 0.25-inch.
 - d. Seismic Restraint: Anchor bolt to concrete pad.
 4. Equipment: Modular Indoor Air-Handling Units without Internal Fan Isolation.
 - a. Base: Steel support base, Type B. Unit integral support base acceptable in lieu of Type B base if certified by manufacturer for isolator point loading.
 - b. Isolators: Restrained spring isolator, Type 3R.
 - c. Minimum Deflection (in.): 2.0-inch.
 - d. Seismic Restraint: None.

2.2 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed.

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2.3 VIBRATION ISOLATORS

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. MW Sausse
5. Vibration Eliminator Co., Inc.
6. Vibration Mountings & Controls/Korfund.

B. Elastomeric Isolator Pads (Isolator Type 1): Oil- and water-resistant elastomer, 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. Material: Standard neoprene
2. Durometer Rating: 50 Maximum.
3. Number of Layers: 1 Unless otherwise noted.

C. Elastomeric Hangers (Isolator Type 2): 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.

D. Restrained Spring Isolators (Isolator Type 3R): Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to ¼-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at a 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.

2.4 SEISMIC-RESTRAINT DEVICES

A. Manufacturers:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control, Inc.
3. Loos & Co., Inc.; Cableware Technology Division.
4. Mason Industries, Inc.
5. TOLCO Incorporated.
6. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
7. Vibration Eliminator Co., Inc.
8. Vibration Mountings & Controls/Korfund.

B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.

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- C. Restraining Cables (Restraint Type C): Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.
- D. Anchor Bolts (Restraint Type C): Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.
- E. Hanger Rod Stiffeners:
 - 1. Steel tube or steel slotted-support system sleeve with internally bolted connections.
 - 2. Reinforcing steel angle clamped to hanger rod.

2.5 FACTORY FINISHES

- 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 electrogalvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-restraint devices for compliance with requirements, 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 INSTALLATION

- A. Install vibration-isolation and seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

3.3 ADJUSTING

- A. Adjust vibration-isolation devices after piping systems have been filled and equipment 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.

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- D. Adjust seismic-restraint devices to permit free movement of equipment within normal mode of operation.
- E. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.4 CLEANING

- A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

3.5 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230548

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SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following HVAC identification materials and their installation:
 - 1. Equipment markers.
 - 2. Access panel and door markers.
 - 3. Pipe markers.
 - 4. Valve tags.
 - 5. Valve schedules.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

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.

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PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. 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.
 - 3. Size: 2-1/2 by 4 inches for equipment.
- B. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide two, 1/8-inch holes for attachment.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Either full-band pipe markers extending 360 degrees around pipe at each location or strip-type pipe markers..
 - 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with approved numbering scheme . Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick brass
 - 2. Material: 3/32-inch- thick laminated plastic with 2 black surfaces and white inner layer.
 - 3. Valve-Tag Fasteners: Brass wire-link or beaded chain.
 - 4. Size: 1-1/2 inch diameter (minimum).

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2.4 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.
 - 2. Frame: Extruded aluminum.
 - 3. Glazing: Single-thickness glass.

PART 3 - EXECUTION

3.1 GENERAL

- A. All identification shall use the room numbers assigned by the Owner. Obtain a list of room numbers from the Owner's Representative prior to preparing identification.

3.2 EQUIPMENT IDENTIFICATION

- A. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment.
 - 1. Letter Size: Minimum 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances.
 - 2. Locate markers where accessible and visible from ground or floor level. Include markers for the following general categories of equipment:
 - a. Meters, and similar units.
 - b. Fuel-burning units, including boilers, furnaces, heaters,.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, mixing boxes, and terminal units.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Water-treatment systems, and similar equipment.
- B. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pre-tensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe for strip-type pipe markers.

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3. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; mechanical rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed 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 nonaccessible 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 along each run. Reduce intervals in areas of congested piping and equipment.
 7. Piping above removable acoustical ceilings.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.7 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.8 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230553

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SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SCOPE

- A. The air distribution systems and hydronic systems shall be balanced by an independent testing, adjusting and balancing (TAB) firm or an Engineering firm with a minimum five years experience in HVAC design and balancing. The TAB firm shall furnish the necessary instruments for making tests, perform balancing work, and issue a certified report of balancing work performed. Balancing reports shall be AABC, NEBB certified or shall be certified by a Registered Professional Mechanical Engineer registered in the State where the project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

- A. TAB work shall not be started until such time as the following conditions are completely fulfilled:
 - 1. Systems shall be completely installed and shall have been successfully test run, and fully operational.
 - 2. Outlets, dampers, balancing devices, and accessories shall be completely installed.
 - 3. Filters and strainers shall be clean.

3.2 INSTRUMENTS

- A. Instruments used for TAB measurements shall be accurate and calibration histories for each instrument shall be available for examination.

3.3 PROCEDURES FOR AIR SYSTEMS

- A. TAB for air systems shall include the following:
 - 1. Set supply fans at design speeds and record average amperage readings on all fan motor phases, static pressures and cfm of air flow in each system.
 - 2. Read air flows at diffusers and grilles with a flow hood or equal air measuring device. Adjust dampers as required.
 - 3. Adjust outside air dampers to scheduled minimum cfm.
 - 4. Adjust fans as required to meet design airflows.
 - 5. Check for drafts, noise and vibration.
 - 6. After balancing is complete, mark final position of balancing dampers.
 - 7. Report any discrepancies.

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3.4 PROCEDURES FOR HYDRONIC SYSTEMS

- A. TAB for hydronic systems shall include the following:
1. Determine total flow by the use of flow meters. With full flow, record total pump head and compare with pump curve and record amperage. Pump curves with operating point indicated shall be included in the balancing report. Record and adjust flow to each coil or terminal by adjusting flow control.
 2. If manual calibrated balancing type valves are used, record each coil or terminal, indicate valve type and size. Record and adjust flow to each coil or terminal by adjusting valve.
 3. If automatic, pre-set type valves are used, record each coil or terminal and valve pressure drop; indicate valve type and size. Make spot checks on flow of approximately 20 percent of the valves and record results.
 4. Report any discrepancies.

3.5 TOLERANCES

- A. Set HVAC system airflow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: +/- 10 percent.
 2. Air Outlets and Inlets: +/- 10 percent.
 3. Hydronic Water Flow Rates: +/- 10 percent.

3.6 REPORTS

- A. Submit, on neat and legible forms, the full, certified report of systems operation, initial and final readings.
- B. Upon completion of TAB of air systems and hydronic systems, prepare a complete and legible preliminary report. Submit 2 copies for review.
- C. Upon verification and approval of the preliminary report, prepare final certified report. Furnish one copy to the Architect, and the remaining 3 copies are to be included in the Owner's Operation and Maintenance Manuals.

END OF SECTION 230593

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SECTION 230700 – HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes insulation systems for HVAC ductwork equipment, Type I kitchen hood exhaust ductwork, and piping.
- B. Related Sections include the following:
 - 1. Division 23 Section "Metal Ducts" for duct liners.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. PVC: Polyvinyl chloride.
- D. SSL: Self-sealing lap.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. For adhesives, sealants and mastics: Documentation including printed statement of VOC content.

1.5 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, 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.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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1.7 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. Nomaco K-Flex.

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- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation without jacket or with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Preformed Pipe Insulation:
1. Products:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 deg. Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

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2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 4. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 3. Solids Content: 63 percent by volume and 73 percent by weight.
 - 4. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire and water resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color:
 - a. White for ASJ and PVC.
 - b. Aluminum for FSK and metal jackets.
- B. VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

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3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mils thick; roll stock ready for shop or field cutting and forming.
 1. Adhesive: As recommended by jacket material manufacturer.
 2. Color: White.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps and mechanical joints.
 4. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:
 1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, Temper H-14; sheet and roll stock ready for shop or field sizing.
 - a. Finish and thickness: Stucco embossed; .016-inch thick minimum.
 - b. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

- A. ASJ Tape: White vapor-barrier tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
- B. FSK Tape: Foil-face, vapor-barrier tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
- C. PVC Tape: White vapor-barrier tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- D. Aluminum-Foil Tape: Vapor-barrier tape with acrylic adhesive and UL listed.

2.9 SECUREMENTS

- A. Insulation Pins and Hangers:
 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, length to suit depth of insulation indicated.

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2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
- D. Bands: Stainless-steel or aluminum with wing seals.

2.10 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. UL tested and certified to provide a 2-hour fire rating.
1. Products:
 - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating.
1. Products:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.
 - g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

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.

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1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or barriers, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

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- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 to 6 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. Do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.
 7. Flexible connector hoses for hydronic coils.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

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1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Non-Rated Interior Wall and Partition Penetrations): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations.
1. Firestopping and fire-resistive joint sealers are specified in Division 07 Section "Fire-Resistive Joint Systems" and 23 Section "Common Materials and Methods for HVAC".
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies according to Division 07 Section "Fire-Resistive Joint Systems" and Division 23 Section "Common Materials and Methods for HVAC".

3.5 DUCT AND PLENUM INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install 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, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

3.6 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

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2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Stagger joints between insulation layers at least 3 inches.
7. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
8. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
9. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
10. Install removable insulating fitting covers on equipment, tanks and vessels where scheduled.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:

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1. Install reusable valve wrap or preformed valve covers manufactured of same material as pipe insulation when available.
2. Install insulation to flanges as specified for flange insulation application.
3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 4 to 6 inches o.c.
3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-barrier integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation. Where preformed fitting insulation is not commercially available, use mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive.
3. Insulate tee fittings with preformed fitting insulation. Where preformed fitting insulation is not commercially available, use sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using reusable valve wrap or preformed fitting insulation. Where preformed fitting insulation is not commercially available, use sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.
5. Insulate strainers using reusable valve wrap or preformed fitting insulation. Where preformed fitting insulation is not commercially available, use sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
8. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

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9. Install reusable valve wrap or removable insulating fabric fitting covers on valves, elbows, tees, and flanges, strainers or other irregularly-shaped fittings or components where fitted PVC covers are not practical or available.
- C. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 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, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- D. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install 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, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

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- b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.9 FIELD-APPLIED JACKET INSTALLATION

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

3.10 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

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1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated or scheduled, secure system to ducts and duct hangers and supports to maintain a continuous UL-listed fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.

3.12 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply, return and outdoor air.
 2. Indoor, exposed supply, return and outdoor air.
 3. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums and casings.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Factory-insulated access panels and doors.

3.13 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- A. If more than one material is listed, selection from materials listed is Contractor's option.
- B. Service: Supply-air and Return-air ducts, within conditioned space.
 1. Material: Mineral-Fiber Board or Mineral-Fiber Blanket.
 2. Minimum R-value: R-3.3.
 3. Field-Applied Jacket: None.
 4. Vapor Barrier Required: Yes.
- C. Service: Outside-air ducts, within conditioned space.
 1. Material: Mineral-Fiber Board or Mineral-Fiber Blanket.
 2. Minimum R-value: R-7.
 3. Field-Applied Jacket: None.
 4. Vapor Barrier Required: Yes.
- D. Service: Supply-air and Return-air ducts, not in conditioned space.

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1. Material: Mineral-Fiber Board or Mineral-Fiber Blanket.
2. Minimum R-value: R-7.
3. Field-Applied Jacket: None.
4. Vapor Barrier Required: Yes.

E. Service: Type I Grease Hood ducts.

1. Material: Fire-Rated Insulation System (2-hour rating).
2. Minimum R-value: N/A.
3. Field-Applied Jacket: None.
4. Vapor Barrier Required: None.

3.14 EQUIPMENT INSULATION SCHEDULE

A. Insulate indoor equipment in paragraphs below that is not factory insulated. If more than one material is listed, selection from materials listed is Contractor's option.

B. Heating-hot-water air-separator:

1. Operating Temperature: 100 to 200 deg. F.
2. Material: Removable Insulating Fabric Fitting Cover.
3. Vapor Barrier Required: None.

3.15 PIPING INSULATION SCHEDULE, GENERAL

A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Fire-suppression piping.
2. Drainage piping located in crawl spaces.
3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.16 INDOOR PIPING INSULATION SCHEDULE

A. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Service: Refrigerant Suction.

1. Operating Temperature: 35 to 50 deg F.
2. Insulation Material: Flexible Elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. All pipe sizes: 1.0 inch
4. Field-Applied Jacket: None.

C. Service: Heating Hot-Water Supply and Return.

1. Operating Temperature: 100 to 200 deg F.
2. Insulation Material: Mineral-Fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 4 inch and Less: 1.5 inch
 - b. Pipe, > 4 inch: 2 inch
4. Field-Applied Jacket: PVC for piping exposed in public spaces to 9 feet above floor level.
5. Vapor Barrier Required: None.

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3.17 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Service: Refrigerant Suction.
 - 1. Operating Temperature: 35 to 50 deg F.
 - 2. Insulation Material: Flexible Elastomeric.
 - 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. All pipe sizes: 1 inch
 - b. Field-Applied Jacket: Aluminum.
 - c. Vapor Barrier Required: None.

END OF SECTION 230700

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SECTION 230800 – COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED WORK

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

1.2 DESCRIPTION OF WORK

- A. This section describes the requirements for start-up and commissioning of Division 23 installed work.
- B. The Contractor shall test and provide written certification that the scheduled mechanical installation complies with contract documents, code, and proper system operation. Perform acceptance tests in accordance with manufacturer recommendations. Complete the installation and start-up checklists and testing procedures.
- C. The Contractor shall provide expert personnel to start-up and test components and systems described in this section and related sections.
- D. Comply with minimum requirements of Washington State Energy Code Section 1416 at a minimum.

1.3 SYSTEMS TO BE COMMISSIONED

- A. The following mechanical systems will be commissioned on this project. The mechanical contractor is required to provide qualified personnel to test these systems.
 - 1. HVAC Equipment and Systems.
 - 2. Automatic Controls.
 - 3. Exhaust and Ventilation Systems.
 - 4. Testing, Adjusting and Balancing.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Comply with Washington State Energy Code Section 1416 as a minimum.

END OF SECTION 230800

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SECTION 230839 – HIGH-VOLUME, LOW-SPEED CIRCULATION FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. High-volume, low-speed (HVLS) circulation fans.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For HVLS fans to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standards: HVLS fans shall comply with UL 507, 746C, 1004, and 1917.

1.5 COORDINATION

- A. Coordinate size and location of structural-steel support members.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Delta T Corporation, dba Big Ass Fans, PO Box 11307, Lexington, Kentucky 40575. Phone (877) 244-3267. Fax (859) 233-0139. Website: www.bigassfans.com

2.2 HVLS CIRCULATION FANS

- A. Complete Unit – POWERFOIL X Model:

1. Fan shall be ETL certified and built pursuant to construction guidelines set forth by UL standards 507, 746C, 1004, 1917 and CSA standards 22.2 No. 4, 22.2 No. 17, 22.2 No. 113, 22.2 No. 100, 22.2 No. 156. The fan shall be designed to move an effective amount of air for cooling and destratification in commercial applications. The fan shall incorporate a gear drive system designed specifically for high volume, low speed fans to ensure silent operation. The sound levels from the fan operating at maximum speed shall not exceed 40 dBA (measured 20 ft. below the blades and 20 ft. horizontally from the center of the fan).

- B. Airfoils:

1. Fan shall be equipped with ten (10) high-volume, low-speed airfoils of precision extruded aluminum alloy. Each airfoil shall be of the high performance Powerfoil design. The airfoils shall be connected by means of two (2) locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with stainless steel retainers.
2. Finish: Brushed Aluminum.

- C. Winglets:

1. Fan shall be equipped with ten (10) TEC winglets designed to redirect outward airflow into downward airflow, thereby enhancing the efficiency and effectiveness of the fan. The winglets shall be high density polypropylene and measure 8-1/2" x 3". A winglet shall be attached at the tip of each airfoil.
2. Finish: Safety Yellow.

- D. Trim:

1. The fan shall be equipped with trim inserts that nest between the hub and the inner edge of the foil. The trim inserts (10 each) shall provide a cleaner fit between the airfoils and the hub to help reduce drag, turbulence and noise. Trim inserts shall be black.

- E. Motor:

1. The fan motor shall be an AC induction type inverter rated at 1725 RPM, 230/460 VAC, and 60 Hz for 3 ϕ and 1725 RPM, 208 VAC, and 60 Hz for 1 ϕ . The motor shall be totally enclosed, fan cooled (TEFC) with an IP55 NEMA classification. NEMA standard frames 56C/143TC/145TC shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in -30°F to 122°F (-34°C to 50°C) ambient conditions.

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F. Gearbox:

1. The fan gearbox shall be designed specifically for high-volume, low-speed circulation fans. The gearbox shall include a high efficiency, hermetically sealed, nitrogen filled, offset helical gear reducer with two stage gearing, cast iron housing, double lip seals, high quality bearings with crowned cages for lubrication flow and precision machined gearing to maintain backlash of less than 11 arc-minutes over the life of the unit. Lubrication shall be non-foaming synthetic oil with extreme pressure additives and a wide operating temperature range.

G. Hub:

1. The fan hub shall be a single precision permanent mold casting of aluminum alloy for high strength and light weight. The hub shall be precision machined to achieve a balanced and solid rotating assembly. The hub shall incorporate ten (10) safety pins made from aluminum that will secure the hub/airfoil assembly in case of shaft failure. The pins shall be attached to the body of the hub using bolts.

H. Mounting System:

1. The fan mounting system shall be designed for quick and secure installation from a structural support beam. All components in the mounting system shall be of welded construction using steel not less than 3/16-inch thick and be powder coated for appearance and resistance to corrosion. All mounting bolts shall be SAE Grade 8 or equivalent.
2. Finish: Powder-coated in one of 9 standard colors.

I. Safety Cables:

1. The fan shall be equipped with upper and lower safety cables. The upper safety cable shall provide an additional means of securing the fan assembly to the building structure. The lower safety cable shall provide an additional means of securing the motor unit to the mounting system. All safety cables shall be 3/8-inch diameter and fabricated out of 7 x 19 stranded galvanized steel. The loops shall be secured with swaged fittings, pre-loaded and tested to 3,000 lb·f.
2. Field construction of safety cables is not permitted.

J. Controller:

1. The controller shall be incorporated into the fan assembly. The controller shall be factory programmed to minimize starting and braking torques. The controller shall be housed in an enclosure to prevent accidental contact with the enclosed equipment and to prevent entry of unwanted substances.
2. The controller shall be equipped with a user interface for controlling the fan's direction, operation and speed from an external signal.

K. Warranty:

1. The manufacturer shall replace any products or components defective in material or workmanship in accordance to the following schedule:
 - a. Airfoils:Limited Lifetime (Parts)
 - b. Hub:Limited Lifetime (Parts)
 - c. Motor:5 years (Parts)
 - d. Controller: 5 years (Parts)
 - e. Labor:1 year

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install HVLS fans level and plumb.
- B. Install and connect units in accordance with the manufacturer's written instructions.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23 Section "Mechanical Identification."
- E. Perform required factory start-up and check-out procedures.

END OF SECTION 230839

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SECTION 230924 – AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Division 23 Section "Sequence of Operation" for requirements that relate to this Section.
 - 2. Division 23 Section "Testing, Adjusting and Balancing" for requirements that relate to this Section.

1.3 SERVICE AND GUARANTEE

- A. The temperature control system(s) as herein specified shall be free from defects in workmanship and material under normal use and service. If within one (1) year from date of Acceptance by the Owner, any of the equipment herein described is proved to be defective in workmanship or material, it shall be replaced or repaired at no expense to the Owner.
- B. The Contractor shall, after completion of the original test of the installation and Acceptance by the Owner, provide any service incidental to the proper performance of the temperature control system under guarantees outlined above for the period of one (1) year, after completion of the installation, the Contractor shall regulate and adjust all equipment provided.

1.4 CODES AND STANDARDS

- A. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.
- B. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.
- C. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide electric control products in sizes and capacities indicated, consisting of dampers, thermostats, sensors and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer as indicated.

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2.2 CONTROL DAMPERS

- A. Low-Leakage Type (Outside Air, Exhaust/Relief Air Applications): Damper frame shall be not less than 16 gage galvanized steel structural hat channel with tabbed corners for reinforcement. Blades shall be single skin, not less than 16 gage galvanized steel with longitudinal grooves for reinforcement. Blade edge seals shall be PVC coated polyester fabric mechanically locked in the blade edge. Jamb seals shall be flexible metal, compression type, to prevent leakage between blade end and damper frame. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Axles shall be square or hexagonal positively locked into the damper blade. Linkage shall be concealed out of the airstream within the damper frame to reduce pressure drop and noise. Control dampers shall be performance tested in accordance with AMCA Publication 500 with leakage not greater than 10 CFM per square foot at 4 in. w.g. when damper is being held by torque of 50 inch-pounds.
- B. Standard Type (Return Air Applications): Damper frame shall be not less than 16 gage galvanized steel structural hat channel with tabbed corners for reinforcement. Blades shall be single skin, not less than 16 gage galvanized steel with longitudinal grooves for reinforcement. Blade edge seals shall be PVC coated polyester fabric mechanically locked in the blade edge. Jamb seals shall be flexible metal, compression type, to prevent leakage between blade end and damper frame. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Axles shall be square or hexagonal positively locked into the damper blade. Linkage shall be concealed out of the airstream within the damper frame to reduce pressure drop and noise. Control dampers shall be performance tested in accordance with AMCA Publication 500 with leakage not greater than 10 CFM per square foot at 4 in. w.g. when damper is being held by torque of 50 inch-pounds.

2.3 CONTROL DAMPER ACTUATORS

- A. Provide electric actuators of sufficient size and reserve power to operate control dampers matched to application as described in the Sequence of Operation. Upon loss of power, actuators shall operate in a fail-safe manner as indicated to be normally open or normally closed, or as required for freeze protection utilizing spring return or capacitors. Actuators shall be designed and listed to operate in the application environment.

2.4 ROOM THERMOSTAT

- A. Programmable type with seven day programming for two occupied and two unoccupied periods per day; individual occupied and unoccupied set points; three hour override of unoccupied program with automatic return to programmed schedule; battery back-up with rechargeable nicad battery; fan "auto" cycle available for both occupied and unoccupied cycles; automatic changeover on heating/cooling sequences. Thermostat shall be Honeywell Focus-Pro 6000, Pro 4000, Line Volt Pro 8000 or equal with appropriate features and accessories.

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PART 3 - EXECUTION

3.1 ELECTRICAL

- A. Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division 16 sections of these specifications. All system controllers, junction boxes, etc. shall be mounted at readily accessible and convenient locations and heights.
- B. Room Temperature Sensors and Thermostats - Mounting Heights:
- C. Room temperature sensors and thermostats with occupant adjustment capabilities shall be mounted with the highest operable part at 54 inches above finished floors where the clear floor space allows parallel approach by a person in a wheelchair.
- D. Room temperature sensors and thermostats with occupant adjustment capabilities shall be mounted with the highest operable part at 48 inches above finished floors where the clear floor space allows only forward approach by a person in a wheelchair.
- E. Room temperature sensors and thermostats without occupant adjustment capabilities shall be mounted at 60 inches above finished floors, unless otherwise specifically indicated on the Drawings.
- F. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electrical control devices.
- G. Wiring System: Install complete control wiring system for electric control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductor's bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

3.2 ADJUSTMENTS

- A. After completion of installation, adjust thermostats, dampers, motors and similar equipment provided as work of this section.

3.3 COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230924

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SECTION 230993 – SEQUENCE OF OPERATIONS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 VENTILATION OPERATING SEQUENCES

- A. Power Ventilators (EF): System starts fan to run continuously or on-off with local manual control as scheduled during occupied periods and stops fan during unoccupied periods.

1.4 ELECTRIC WALL HEATERS

- A. Sequence Description: Provide programmable room thermostat to maintain space temperature by cycling fan motor and electric element as required to satisfy setpoint. Provide integral time to continue fan operation until element temperature falls below pre-set point.

1.5 DUCTED HEAT PUMP (HVAC-1)

- A. Sequence Description:
 - 1. Warm-up Cycle: Operate HVAC system continuously on 100% return air and at full heat to bring space temperature up to Occupied Cycle setpoint.
 - 2. Cool-down Cycle: Operate HVAC system continuously with outdoor air (economizer) only until space temperature is at Occupied Cycle setpoint.
 - 3. Occupied Cycle:
 - a. Operate supply fan continuously with outdoor air damper open to set minimum position (adjustable).
 - b. On a call for space heating, energize heat pump/heating on unit gas valve to satisfy room sensor setpoint. Upon a further call for heating, open hot water heating valve.
 - c. On a call for space cooling, modulate the outdoor air, return air dampers on an economizer cycle. Provide a discharge air temperature sensor to maintain minimum supply air temperature of 60 deg.F. Upon a further temperature rise, energize direct expansion (DX) mechanical cooling to satisfy room sensor setpoint. The integrated economizer control shall be capable of providing a portion of the cooling load requirements even when additional mechanical cooling is required to meet the remainder of the load. The economizer control shall be limited by a mixed air low-limit temperature sensor set at 55 deg.F and outdoor air high-limit

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temperature sensor set at 75 deg.F. to return the outdoor air damper to minimum position.

- d. The mixed air low-limit temperature sensor shall modulate the outdoor air and return air dampers as required to maintain minimum 55 deg.F entering air temperature to unit heat exchanger.
- 4. Unoccupied Cycle:
 - a. De-energize unit fan, close outdoor air (and relief air damper if utilized) damper and open return air damper.
 - b. Cycle unit fan with either heating or cooling mode to maintain Unoccupied Cycle room temperature setpoints.
 - c. An override button on the room thermostat shall return the space to Occupied Cycle mode for a user-defined duration.

1.6 AIR HANDLING UNIT

- A. Sequence Description: Provide programmable room thermostat with modulating output signal to maintain space temperature by cycling fan motor and modulating 3-way hot water heating valve as required to satisfy setpoint. Thermostat shall have fan "on – auto" switch.

1.7 MAINTENANCE BAY VENTILATION

- A. Sequence Description: Provide two carbon monoxide monitors and one NOX sensor to start AHU fan and open outside air intake and exhaust dampers when carbon monoxide ppm rises above set point. Also provide manual switch to start AHU fan and open outside air and exhaust dampers when turned on.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 230993

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SECTION 232113 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes piping, special-duty valves, and hydronic specialties for hot-water heating and chilled-water cooling; and condensate drain piping.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Materials and Methods for HVAC" for general piping materials and installation requirements.
 - 2. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
 - 3. Division 23 Section "General-Duty Valves for HVAC Piping" for general-duty ball, butterfly and check valves.
 - 4. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
 - 5. Division 23 Section "Instrumentation and Control for HVAC" for temperature-control valves and sensors, and electronic, paddle-or insertion type flow meters.

1.3 SUBMITTALS

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- B. Welding Certificates: Copies of certificates for welding procedures and personnel.
- C. Operation and Maintenance Data: For hydronic specialties and special-duty valves to include in operation and maintenance manuals.
- D. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style number.

1.4 QUALITY ASSURANCE

- A. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

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- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations.
- 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.
- F. Coordinate installation of hydronic instrument wells, temperature-control valves and other accessories.
- G. Coordinate installation of pipe sleeves for penetrations through wall, floor and roof assemblies. Coordinate with requirements for firestopping specified for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Anvil International, "Gruvlok" Series.
 - b. Victaulic Company of America
 - 2. Steel Pressure-Seal Fittings:
 - a. Victaulic Company of America.
 - 3. Flexible Connectors:
 - a. Flexicraft Industries
 - b. Flex-Hose Co.
 - c. Hyspan Precision Products
 - d. Keflex
 - e. Mason Industries
 - f. Proco Products, Inc.
 - g. Vibration Mountings and Controls, Inc.
 - 4. Calibrated Balancing Valves:
 - a. Armstrong Pumps, Inc.
 - b. Flow Design, Inc.
 - c. Griswold Controls
 - d. ITT Bell & Gossett
 - e. Nexus Valve
 - f. Nibco

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- g. Taco, Inc.
- h. Tour and Andersson
- i. Victaulic Company of America
- 5. Safety Valves:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT McDonnell & Miller Div
 - e. ITT Bell & Gossett
 - f. Taco, Inc.
 - g. Watts Regulators
- 6. Automatic Flow-Control Valves, Coil Piping Packages:
 - a. Flow Design, Inc.
 - b. Griswold Controls
 - c. Hays Fluid Controls
 - d. ITT Bell & Gossett
- 7. Expansion Tanks:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. ITT Bell & Gossett
 - d. John Wood Company
 - e. Taco, Inc.
 - f. Watts Industries, Inc.
- 8. Air & Dirt Separators:
 - a. Spirotherm, Inc.
- 9. Air Vents:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps
 - c. Caleffi
 - d. Conbraco Industries, Inc.
 - e. ITT Bell & Gossett
 - f. Spirotherm, Inc.
 - g. Taco, Inc.

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; ASTM B 88, Type M (condensate drains only).
- B. Cast Copper Alloy Fittings: ASME B16.18.
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.

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- F. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- G. Solder Filler Metals: ASTM B 32, 95-5 tin antimony solder.
- H. Brazing Filler Metals: AWS A5.8, Classification BAg-1, 15% silver alloy.

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Grade B, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2 and Smaller: ASTM A 135 or ASTM A53, Schedule 5, carbon steel with plain ends and zinc-plated finish.
- C. Steel Pipe, NPS 2-1/2 to NPS 6: ASTM A 53, Grade B, Schedule 10 or Schedule 40, black steel, plain ends.
- D. Steel Pipe, NPS 8 and Larger: ASTM A 53, Grade B, Schedule 20 or Schedule 40, black steel, plain ends.
- E. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
- F. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- G. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- H. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- I. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- J. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- K. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron fittings with grooves or shoulders designed to accept grooved end couplings of the same manufacturer.
 - 2. Grooved Mechanical-Joint Couplings: Ductile iron housing and EPDM (Grade E) gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings; rigid type or flexible type where flexibility or expansion is required in steel piping systems. Gasket temperature range -30 deg.F to +230 deg.F.
 - a. Rigid Type: Coupling housings cast with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.

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- b. Flexible Type: Use in locations where vibration attenuation and stress relief are required.
 - c. Flange Adapters: Flat face, for direct connection to ANSI Class 125 or 150 flanged components.
- L. Steel Pressure-Seal Fittings:
- 1. Housing: Steel.
 - 2. O-Rings and Pipe Stop: EPDM.
 - 3. Tools: Manufacturer's special tool.
 - a. Furnish pressure-seal assembly tool to Owner at completion of Project.
 - 4. Minimum 300-psig working-pressure rating at 230 deg F.
- M. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- N. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 VALVES

- A. Gate, check, ball, and butterfly valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- C. Calibrated Balancing Valves NPS 2 and Smaller: Bronze or brass body, "Y" pattern equal percentage globe type, 300-psig maximum working pressure, 230 deg F maximum operating temperature, and having threaded ends. Valve shall provide multi-turn, 360 degree adjustment with micrometer type indicator on valve handwheel. A preset function with locking device shall allow return to original setting after shutoff. Valve shall have connections for portable differential pressure meter.
- D. Calibrated Balancing Valves, NPS 2-1/2 and larger: Ductile iron or steel body "Y" pattern equal percentage globe type, 300-psig maximum working pressure, 230 deg F maximum operating temperature, and having flanged or grooved ends. Valve shall provide multi-turn, 360 degree adjustment with micrometer type indicator on valve handwheel. A preset function with locking device shall allow return to original setting after shutoff. Valve shall have connections for portable differential pressure meter.
- E. Automatic Flow-Control Valves: Factory set to maintain constant flow with plus or minus 10 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, service, valve number, and flow rate. Valve shall be of one of the following designs:
- 1. NPS 2 and Smaller: Combination assembly, including brass Y-type valve body, integral ball valve, stainless-steel wear surfaces with easily removable stainless-steel piston-spring assembly, union, and two pressure and temperature test plugs; 300 psig at 250 deg F. minimum rating; 5 year product warranty, threaded-end connections.

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2. NPS 2 and Smaller: Combination assembly, including brass Y-type valve body, integral ball valve, precision sculptured brass or polyphenylsulfone orifice with elastomeric diaphragm flow control, union, and two pressure and temperature test plugs; 300 psig at 250 deg F. minimum rating; 5 year product warranty, threaded-end connections.
3. NPS 2-1/2 and Larger: Brass or ductile iron body, stainless-steel wear surfaces with stainless-steel piston-spring assembly; 300 psig at 250 deg F. minimum rating; 5 year product warranty, flanged-end connections.
4. NPS 2-1/2 and Larger: Ductile iron or carbon steel body, precision sculptured brass or polyphenylsulfone orifice with elastomeric diaphragm flow control; 300 psig at 250 deg F. minimum rating; 5 year product warranty, flanged-end connections.

F. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

2.6 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.
- C. Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible bladder securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- D. Air and Dirt Separator: Welded black steel, ASME constructed and labeled for 125-psig minimum working pressure and 250 deg F maximum working temperature; integral copper wire fin bundle coalescing medium or high surface pall rings designed to vent accumulated air out automatic valve; separate air and venting chamber to prevent system contaminants from damaging the float and venting valve operation; valved side tap for quick bleeding of air during system fill; extended vessel bottom for dirt separation and collection chamber with blowdown valve; threaded connections for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger. Size unit for less than 1.5 ft. pressure drop and velocity not to exceed 4 FPS at design flow rate. Spirotherm "Spirovent Dirt" Series.
- E. Y-Pattern Strainers: 300-psig maximum working pressure; cast-iron body (ASTM A 126, Class B) or ductile iron (ASTM A 536), flanged or grooved ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- F. T-Pattern Strainers: 300-psig maximum working pressure; ductile-iron or fabricated carbon steel body, grooved-end connections, stainless-steel basket with 57 percent free area; removable access coupling and end cap for strainer maintenance.

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- G. Flexible Fire-Rated Hoses: NPS 1/2 to NPS 2, E84-80 EPDM inner tube with stainless steel braided cover; 400-psig working pressure and 230 deg F maximum operating temperature; brass swivel fittings with threaded ends; fire-rating not exceeding flame-spread-25/smoke density-50; length as required.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot Water Heating (below slab radiator runouts, up to 200 deg.F): Use the following piping materials:
 - 1. NPS 1 and Smaller: PEX/AL/PEX tubing with compression or crimp joints.
- B. NPS 2 and Smaller
- C. Hot Water Heating (up to 230 deg.F): Use any of the following piping materials for each size range:
 - 1. NPS 2 and Smaller: Type L drawn-temper copper tubing with brazed joints.
 - 2. NPS 2 and Smaller: Schedule 40 steel pipe; Class 125, cast iron or Class 150 malleable-iron fittings; with threaded joints.
 - 3. NPS 2 and Smaller: Schedule 5 light-wall steel pipe with steel pressure-seal joints.
 - 4. NPS 2 and Smaller: Schedule 5 stainless-steel pipe with stainless-steel pressure-seal joints.
 - 5. NPS 2-1/2 to NPS 6: Type L drawn-temper copper tubing with brazed or grooved joints.
 - 6. NPS 2-1/2 to NPS 6: Schedule 10 or Schedule 40 steel pipe with grooved joints.
- D. Air-Conditioning Condensate Drain Lines:
 - 1. Type M drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Ball and butterfly valves.
 - 2. Throttling Duty: Ball and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- C. Install coil piping package in the supply water line of each fan coil unit heating and cooling element and elsewhere as indicated.
- D. Install calibrated balancing valve in the return water line of each equipment heating and cooling element, and elsewhere as indicated. Do not install calibrated balancing valve where automatic flow -control valve is indicated.
- E. Install spring-loaded check valves at each pump discharge and elsewhere as required to control flow direction.

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- F. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
- G. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.
- H. Install hydronic instrument wells, temperature-control valves and other accessories in accordance with manufacturer's written instructions for intended application.
- I. All valves shall be located so they are easily accessible for maintenance.

3.3 PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Common Materials and Methods for HVAC" for basic piping installation requirements.
- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- E. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- F. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- G. Anchor piping for proper direction of expansion and contraction.
- H. Unless otherwise indicated, use unions, flanges and couplings downstream of valves and at equipment apparatus connections. Do not use direct welded or threaded connectors for valves, equipment or other apparatus'. Use non-conducting dielectric connections when joining dissimilar metals in open piping systems.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing of supports.
- B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.

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3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
- C. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 7. NPS 4: Maximum span, 10 feet; minimum rod size, 1/2 inch.
- D. Install hangers for Schedule 5 steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1/2: 72 inches with 3/8 inch rod.
 2. NPS 3/4: 84 inches with 3/8 rod.
 3. NPS1: 96 inches with 3/8 inch rod
 4. NPS 1-1/4: 108 inches with 3/8 inch rod.
 5. NPS 1-1/2: 10 feet with 3/8 inch rod.
 6. NPS 2: 11 feet with 3/8 inch rod.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Materials and Methods for HVAC" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping.
- B. 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.
- C. 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.
- 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 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.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

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- F. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- G. Pressure-Seal Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- H. Grooved joints: Select correct type of gasket for system application and temperature. Assemble joints with keyed-coupling housing, gasket, extreme temperature lubricant, and bolts according to coupling manufacturer's written instructions. 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. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. 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 inspect the product installation. Contractor shall remove and replace any improperly installed products.
 - 1. Coupling Application: Rigid type for all joints except where flexible type specifically indicated or required for piping expansion or to provide vibration isolation from mechanical equipment connections in steel piping systems. Install factory fabricated and assembled, multiple flexible type coupling sets where required for piping expansion.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents in mechanical equipment rooms where indicated. Pipe vent outlet to drain where feasible.
- C. Install expansion tanks on floor or as indicated. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.
- D. Install flowmeter elements in accessible positions in piping systems.
- E. Install connection fittings for attachment to portable indicators in accessible locations

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.

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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. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Notify Commissioning Authority 48 hours in advance of hydronic piping leak testing.

3.9 ADJUSTING

A. Mark calibrated nameplates of pump discharge and calibrated balancing valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic valves.
7. Check and set operating temperatures of boilers and chillers to design requirements.
8. Lubricate motors and bearings.

3.10 CLEANING

A. See Division 23 Section "HVAC Water Treatment" for cleaning requirements of hydronic piping systems.

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3.11 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 232113

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SECTION 232123 – HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Vertical In-line Centrifugal pumps.
- B. Related Sections include the following:
 - 1. Division 23 Section “Common Motor Requirements for HVAC Equipment” for general motor requirements.
 - 2. Division 23 Section “Hydronic Piping” for flexible connectors.

1.3 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities; installed, and operating weights; furnished specialties; final impeller dimensions; and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. One copy of any manufacturer's installation and start up instructions, plus manufacturer's approved forms shall be provided to the Commissioning Authority at the time of equipment submittals.
- C. Maintenance Data: For pumps to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

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- E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

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. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. In-Line Centrifugal Pumps:
 - a. Armstrong Pumps, Inc.
 - b. ITT Bell & Gossett
 - c. PACO/Grundfos CBS
 - d. Taco, Inc.
 - e. Wilo - USA

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Description: Horizontal or vertical shaft mounting, in-line, centrifugal, single-stage, bronze-fitted, radially split case design; rated for 125-psig minimum working pressure and a continuous water temperature of 225 deg F; close-coupled design.

1. Casing: Cast iron, with threaded companion flanges for piping connections, and threaded gage tapings at inlet and outlet connections.
2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
3. Shaft and Sleeve: Steel, with copper-alloy sleeve.
4. Seals: Mechanical type. Include carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
5. Pump Bearings: Permanently lubricated ball bearings.
6. Motor Bearings: Permanently lubricated ball bearings.
7. Motor: Resiliently mounted to pump casing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.

1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

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

3.2 PUMP INSTALLATION

- A. Install pumps according to manufacturer's written instructions.
- B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Suspend in-line pumps using continuous-thread hanger rod and vibration-isolation hangers.

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. Connect piping to pumps. Install valves that are the same size as piping connected to pumps or of size indicated.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles as indicated.
- E. Install check valve, balancing valve and shutoff valve on discharge side of vertical in-line pumps.
- F. Install shutoff valve on suction side of vertical in-line pumps.
- G. Install pressure gage with snubber at pump suction and discharge tappings. Provide gauge cocks between integral suction and discharge tappings and pressure gauges.
- H. Coordinate electrical connection requirements with Division 26.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Check piping connections for tightness.
 3. Clean strainers on suction piping.
 4. Verify that electrical wiring installation complies with manufacturer's written instructions.
 5. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.

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- c. 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.
- 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
- 7. Verify that pump controls are correct for required application.
- 8. Start motor.
- 9. Open discharge valve slowly.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for detailed requirements for testing, adjusting, and balancing hydronic systems.
- C. Equipment start up shall be witnessed by the Commissioning Authority. Coordinate with Commissioning Authority 48 hours prior to scheduled equipment start up.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.
- B. Coordinate training demonstrations with the Commissioning Authority.

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 232123

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SECTION 232500 – HVAC WATER TREATMENT

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 water treatment systems and equipment for the following:
 - 1. Heating, hot water piping (closed-loop system).
 - 2. Chilled water piping (closed-loop system).
 - 3. Electrical wiring of components to source unless indicated otherwise.

1.3 SUBMITTALS

- A. Product data: Provide chemical treatment materials, chemicals, and equipment including rated capacities, electrical characteristics and connection requirements.
- B. Shop Drawings: Provide system schematic, indicate equipment locations, controls schematic, electrical characteristics and connections requirements.
- C. Manufacturer's Field Reports:
 - 1. Indicate startup of treatment systems when completed and operating properly.
 - 2. Indicate analysis of system water after cleaning and after treatment.
- D. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- E. Maintenance Data: Include data on chemical feed pumps, and other equipment including spare parts lists, procedures including target concentrations to include in operation and maintenance manuals. Include the volume of fluid in each system.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the chemical treatment manufacturer for both installation and maintenance of chemical treatment equipment required for this Project.
 - 1. Approved Installers:
 - a. Flint Services
 - b. IAT Companies
 - c. King Soft Water
- B. Single Source Responsibility: A single water treatment company for undivided responsibility of system startup, system check, water samples, analysis, cleaning, flushing, and testing.
- 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.

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1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable codes and regulations for addition of non-potable chemicals to building mechanical systems, and to public sewage systems.

1.6 MAINTENANCE SERVICE

- A. Furnish service and maintenance program of HVAC water treatment systems for one year from Date of Substantial Completion.
- B. Provide technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements and corrective actions needed. Submit two copies of field service report to the Owner's representative after each visit. Schedule:
 - 1. Closed-loop systems: Minimum of four visits per year on a quarterly basis.
- C. Provide laboratory and technical assistance services during this maintenance period.
- D. Provide training for operating personnel, including installation, maintenance, testing, and operation of water treatment systems. Arrange training to occur at start-up of systems.
- E. Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations to Owner in writing base upon these inspections.

1.7 EXTRA MATERIALS

- A. Provide sufficient chemicals for treatment and testing for one year from the date of Substantial Completion.

PART 2 - PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 Articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed.

2.2 CHEMICALS

- A. Manufacturers:
 - 1. Betz-Dearborn
 - 2. Chem-Aqua
 - 3. CH2O
 - 4. Dow Chemical
 - 5. ONDEO Nalco Company

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- B. System Cleaner:
 - 1. A phosphate wetting agent combined with an alkaline surfactant with a sodium carbonate type alkalinity supplement introduced as necessary to produce 600 PPM of phenolphthalein alkalinity; non-toxic.
 - C. Freeze Protection:
 - 1. Glycol: Dow Chemical "Dowfrost HD" mixed with deionized (DI) water.
 - 2. Inhibitors: Nitrate inhibitor package to provide protection for both ferrous and nonferrous metals.
- 2.3 BY-PASS FEEDER
- A. Manufacturers:
 - 1. IAT Construction Services Inc.
 - 2. A and F Machine Products
 - 3. J.L. Wingert Co.
 - B. By-pass Feeder: Cast iron or steel, for introducing chemicals into closed-loop hydronic systems.
 - 1. Design working pressure: 125 psig.
 - 2. Maximum working temperature: 200 deg.F.
 - 3. Quick opening cap or 6 inch funnel with shutoff valve on top for introduction of chemical.
 - 4. Drain valve on bottom.
 - 5. Recirculating shutoff valves on sides
 - C. Capacity:
 - 1. System volume up to 500 gallons: 2 gallon feeder.
 - 2. System volume greater than 500 gallons: 5 gallon feeder.
- 2.4 TEST EQUIPMENT
- A. Provide basic water test equipment for determination of treatment residuals. Include carrying case and reagents for use with the supplier's products. Provide supplementary or specialized equipment where required.
 - 1. Test equipment for glycol: Furnished and approved by the glycol manufacturer. Misco 7084 VP+ refractometer.

PART 3 - PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that systems are filled, started, vented and operational prior to cleaning. Use water meter to record capacity in each system. Record capacity and include in operation and maintenance manuals.
- B. Make temporary piping connections, furnish temporary pumps, and temporary bypass filter as required to properly accomplish all cleaning operations.
- C. Place all manual and control valves serving main coil banks and terminal control units in open position during cleaning so that circulation through the mains and runouts is obtained during cleaning.

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- D. Verify that electric power is available and of the required characteristics.

3.2 INSTALLATION

- A. Install all water treatment equipment level and plumb.
- B. Provide all piping for water treatment system connections unless indicated otherwise.
- C. Install water treatment systems in strict accordance with the manufacturer's diagrams and recommendations, including all piping and electrical connections.

3.3 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.

3.4 CLEANING SEQUENCES

A. Initial Flush

1. Completely fill system with fresh water and circulate (1st filling).
2. Remove all contaminants such as cuttings, filings, loose rust & scale, welding & soldering residue and debris with initial flushing.
3. Continually drain and refill entire system with fresh water (2nd filling).

B. Closed-Loop Systems

1. Add recommended dosage of cleaning solution to system based on capacity, circulate and bring up to normal system operating temperature.
2. Test solution for proper concentration and document results.
3. Circulate solution for time recommended by manufacturer (4 hours minimum; not to exceed manufacturer's maximum limit).
 - a. Partially close and reopen all manual valves several times.
 - b. Operate all automatic valves through several cycles.
 - c. Continually drain and refill entire system with fresh water 3rd filling).
4. With circulation pump running:
 - a. Open one or more drains as far downstream from fill point as is possible. Confirm makeup water is sufficient to maintain a full system.
 - b. Partially close and reopen all manual valves several times.
 - c. Blowdown all strainer, dead legs and low points in system.
 - d. Operate all automatic valves through several cycles.
 - e. Continue to flush system in this manner until drain water is of same clarity as makeup water and testing reveals no further traces of cleaning solution (minimum 1 hour). Document results.
5. Following fresh water flush, drain entire system.
 - a. Clean all strainers.
 - b. Remove all startup strainers.
6. Fill System (Glycol Systems).
 - a. Fill system with required quantity of propylene glycol.
 - b. Complete filling of system with deionized (DI) water.
 - c. Add glycol solution within 2 hours after final draining of system.

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- d. Clearly tag each system as follows:
“CAUTION - THIS SYSTEM HAS BEEN “CHARGED” WITH GLYCOL. DO NOT DILUTE SYSTEM WITH WATER OR DRAIN SYSTEM WITHOUT AUTHORIZATION.”

C. Boilers

1. Boil out boilers at start-up, prior to flushing piping systems using a formula consisting of an alkalinity supplement, dispersants and a phosphate compound. Introduce solution at a rate sufficient to produce phenolphthalein alkalinity test result of 600 PPM. Circulate solution for a minimum of four hours duration, then thoroughly drain and flush. Refer to installed boiler manufacturer's instructions for additional requirements.
 2. Use neutralizer agents on recommendation of system cleaner supplier.
 3. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.
 4. Add specified treatment chemicals as soon as possible after cleaning and flushing. Add treatment chemicals within two hours of filling system with clean water.
- D. Upon completion of cleaning and chemical treatment addition, clearly tag each system as follows: **“THIS SYSTEM HAS BEEN CHEMICALLY CLEANED AND TREATED”**.

3.5 DEMONSTRATION

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.
- B. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
- C. Coordinate all demonstrations and training with the Commissioning Authority at least two weeks in advance.

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 232500

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SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2-inch to plus 10-inch wg. Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
 - 2. Single-wall, round, and flat-oval ducts and formed fittings.
 - 3. Duct liner.
 - 4. For adhesives, sealants and mastics: Documentation including printed statement of VOC content.
- B. Related Sections include the following:
 - 1. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors, turning vanes, and flexible ducts.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

1.4 DEFINITIONS

- A. NAIMA: North American Insulation Manufacturers Association.
- B. SMACNA: Sheet Metal and Air Conditioning Contractors National Association.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct liner.

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PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation. Where specifically indicated, ducts shall have "galvaneal" ("paint-grip") finish for surfaces to be painted.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DUCT LINER

- A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
 - 1. Manufacturers:
 - a. CertainTeed Corp.; Insulation Group; "ToughGard2" or "ToughGard R" Duct Liner.
 - b. Johns Manville International, Inc.; "Linacoustic RC" Duct Liner.
 - c. Johns Manville International, Inc.; "Spiracoustic Plus", "Spiracoustic" Round Duct Liner.
 - d. Knauf Fiber Glass GmbH.; "Duct Liner E-M".
 - e. Owens Corning.; "QuietR" Duct Liner.
 - 2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated with tightly bonded non-woven mat to prevent erosion of glass fibers and to facilitate duct cleaning.
 - a. Thickness: 1 inch unless otherwise indicated.
 - b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - c. Anti-Bacterial and Fungal Prevention: EPA-registered anti-microbial agent treatment in airstream surfaces applied to aid in the prevention of fungal and bacterial growth. Comply with ASTM C 1338, ASTM G21, ASTM G22.
 - d. Maximum Emissions Levels:
 - e. Formaldehyde: 0.05 ppm
 - f. Total Volatile Organic Compounds (TOVC): 0.50 mg/m³
 - g. Total Particles: 0.05 mg/m³
 - h. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - i. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - 1) VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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- j. Mechanical Fasteners: Galvanized steel suitable for welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
 - 1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
 - 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
 - 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

2.3 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 1. VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
 - 1. VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
 - 1. VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
 - 1. VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

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2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized Steel Ducts: Galvanized steel shapes and plates.
 2. Supports for Stainless Steel Ducts: Stainless steel support materials.
 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," using corner, bolt, cleat, and gasket details.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 22 gage or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.
- E. Duct Dimensions: Unless specifically indicated, duct dimensions on the Drawings are net free areas. Increase duct dimensions as necessary to compensate for liner thickness.
- F. Elbow Configuration:
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows." Rectangular duct elbow configuration shall be one of the following types unless specifically indicated otherwise:
 - a. Radius Type RE 1 with minimum 1.5 radius-to-width (R/W) ratio. Square throat radius elbows (R/W ratio of 0.5) are not allowed.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-width (R/W) ratio and two splitter vanes.

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- c. Mitered Type RE 2 with turning vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 1) Exception: Vanes not required for general purpose exhaust-air, return-air, and relief-air ducts where duct velocity is 1000 fpm or lower AND duct net inside area is 144 sq. in. (1.0 sq. ft.) or less.
 - 2) Exception: Maximum velocity limitation: 1500 fpm.

G. Branch Configuration:

- 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection." Rectangular duct branch configuration shall be one of the following types unless specifically indicated otherwise:
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin-in fitting.

2.6 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. 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.
- B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Apply adhesive coating on longitudinal seams in ducts where air velocities are greater than 2500 fpm.
- G. 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.
- H. 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:
 - 1. Fan discharges.
 - 2. Intervals of lined duct preceding unlined duct.
 - 3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

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- I. For double-wall (insulated) ducts, secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - 1. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
- J. Terminate inner ducts with build outs attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build outs (metal hat sections), or other build out means are optional; when used, secure build outs to duct walls with bolts, screws, rivets, or welds.

2.7 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Duct Dimensions: Unless specifically indicated, duct dimensions on the Drawings are net free areas. Increase duct dimensions as necessary to compensate for liner thickness.
- C. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- D. Flat-Oval, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- E. Manufacturers:
 - 1. Accu Duct Mfg.
 - 2. ACI
 - 3. Ductmate Industries, Inc.
 - 4. L&R Fabrication - Spokane
 - 5. Lindlab, Inc.
 - 6. Semco Mfg., Inc.
 - 7. Spiral Pipe of Texas
 - 8. United Sheet Metal Div. United McGill Corp.
 - 9. Ventline, Inc.
- F. Duct Joints:
 - 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 - 3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
 - 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - 5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

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- G. Tees and Lateral Taps: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- H. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- I. Elbow Configuration:
 - 1. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.
- J. Branch Configuration:
 - 1. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct only.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
 - 1. Supply Ducts: 1-inch wg.
 - 2. Return Ducts (Negative Pressure): 1-inch wg.
 - 3. Exhaust Ducts (Negative Pressure): 0.5-inch wg.
- B. All ducts shall be standard galvanized steel.

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round duct liner products in accordance with the manufacturer's application guidelines.
- C. Install round and flat-oval ducts in lengths not less than 10 feet unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, size, and shape and for connections.

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- F. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- G. Secure ductwork joints and fittings for materials-handling applications such as clothes dryers and sawdust collection systems with fastening devices that do not extend into the duct and airstream.
- H. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- I. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- J. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- K. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- L. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- M. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- N. Cap or seal temporary duct openings during construction. Remove caps or seals for final connections.
- O. Electrical Equipment Spaces: Route ducts to avoid passing through and above transformer vaults and electrical equipment spaces and enclosures.
- P. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- Q. Fire Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories."
- R. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- S. Protect duct interiors from the elements and foreign materials until building is enclosed.
- T. Paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream of registers and grilles where bare sheetmetal is visible from a normal viewer position. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer.

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3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
 - 1. For pressure classes lower than 2-inch wg, seal transverse joints.
- B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories." Locate flexible connectors in sections of ductwork below roof level for roof mounted equipment unless indicated otherwise.
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 233113

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SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Turning vanes.
4. Duct-mounting access doors.
5. Combination fire and smoke dampers.
6. Flexible connectors.
7. Flexible ducts.
8. Spin-in fittings.
9. Vehicle exhaust door ports and tubing.

- B. Related Sections include the following:

1. Division 23 Section "Automatic Temperature Controls" for control dampers and damper actuators.

1.3 SUBMITTALS

- A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. Duct-mounting access doors.
4. Combination fire and smoke dampers.
5. Flexible connectors.
6. Flexible ducts.
7. Spin-in fittings.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA Standard 500 for maximum leakage rates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers:
 1. Air Balance, Inc.
 2. American Warming and Ventilating.
 3. CESCO Products.
 4. Duro Dyne Corp.
 5. Greenheck.
 6. Penn Ventilation Company, Inc.
 7. Pottorff
 8. Ruskin Company.
 9. Vent Products Company, Inc.
- B. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop,.
- C. Maximum Leakage Rates:
 1. For dampers 24 inches or smaller in either dimension: 40 cfm/sq.ft. at 1.0 inch w.g.
 2. For all other damper dimensions: 20 cfm/sq. ft. at 1.0 inch w.g.
- D. Frame: 0.090-inch- thick extruded aluminum, with mitered corners.
- E. Blades: 0.025-inch- thick, roll-formed aluminum.
- F. Bearings: Non-corrosive synthetic.
- G. Blade Seals: Vinyl.
- H. Blade Axles: Nonferrous.
- I. Linkage Tie Bars and Brackets: Aluminum, concealed in frame.

2.4 VOLUME DAMPERS

- A. Manufacturers:

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1. Air Balance, Inc.
 2. American Warming and Ventilating.
 3. Greenheck.
 4. Johnson Controls, Inc.
 5. Nailor Industries Inc.
 6. Penn Ventilation Company, Inc.
 7. Pottorff
 8. Ruskin Company.
 9. Vent Products Company, Inc.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- C. Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design, standard leakage rating, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 16 gage, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 16 gage, galvanized sheet steel; maximum 6-inch width.
 3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 4. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet; maximum 6-inch width..
 5. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum; maximum 6-inch width.
 6. Blade Axles: Nonferrous.
 7. Bearings: Molded synthetic.
 8. Tie Bars and Brackets: Aluminum.
- D. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting. Provide concealed type regulators, utilizing miter gears and universal joints as required, for dampers located above hard ceilings or in non-accessible locations.

2.5 TURNING VANES

- A. Manufactured Turning Vanes: Single-wall vanes of galvanized sheet steel set into vane runners with friction insert tabs.
1. Manufacturers:
 - a. Ductmate Industries, Inc.

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b. Duro Dyne Corp.

2.6 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include 1-by-1-inch butt or piano hinge and cam latches.
1. Manufacturers:
 - a. American Warming and Ventilating.
 - b. CESCO Products.
 - c. Ductmate Industries, Inc.
 - d. Greenheck.
 - e. Kees.
 - f. McGill AirFlow Corporation.
 - g. Pottorff
 - h. Nailor Industries Inc.
 - i. Ruskin Company
 - j. Ventfabrics, Inc.
 2. Frame: Minimum 22 gage galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- D. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
1. Air Balance, Inc.
 2. CESCO Products.
 3. Delta Control Products.
 4. Greenheck.
 5. Nailor Industries Inc.
 6. Penn Ventilation Company, Inc.
 7. Pottorff.
 8. Ruskin Company.
 9. Safe-Air.
- B. Fire Rating Classification: Labeled according to UL 555S, 1-1/2-hour rating.
- C. Application:
1. Suitable for duct velocities to 2000 fpm and pressures to 4 inch wg.
 - a. Frame: 16 gage, galvanized sheet steel.
 - b. Blades: 16 gage, galvanized sheet steel, triple v-groove blade design.
 - c. Leakage Class II.

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2. Suitable for duct velocities to 4000 fpm and pressures to 4 inch wg.
 - a. Frame: 16 gage, galvanized sheet steel.
 - b. Blades: Airfoil-shaped, double skin, single piece construction with 13 gage equivalent thickness.
 - c. Leakage Class I.
- D. Mounting Sleeve: Factory-installed, 20 gage or heavier galvanized sheet steel as required by UL fabrication procedures and of length to suit wall or floor application.
- E. Controlled Closure Device: Quick detect, heat actuated release device to prevent duct and HVAC component damage, 165 deg F rated. Instantaneous damper closure and replaceable fusible links are not acceptable.
- F. Electric Actuators:
 1. UL 555S Listed for 350 deg.F.
 2. Operation time 15 seconds or less (open or closed).
 3. Manufactured under ISO 9001 quality control.
 4. Factory-installed at time of damper fabrication.
 5. Rated for energized hold open positions of 6 months or more.
 6. Electrical connection: 120-V, 60 Hz.; single-point connection for multiple-section dampers.
 7. 5 year manufacturer's warranty.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Corp.
 3. Ventfabrics, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 24 gage, galvanized sheet steel.
- D. 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 20 to plus 200 deg F.

2.9 FLEXIBLE DUCTS

- A. Manufacturers:
 1. Ductmate Industries, Inc.
 2. Flexmaster U.S.A., Inc.
 3. Hart & Cooley, Inc.
 4. McGill AirFlow Corporation.
 5. Thermaflex
- B. Insulated-Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; 1 inch fibrous-glass insulation; polyethylene vapor barrier film.

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1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 175 deg F.
- C. Insulated-Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; 1 inch fibrous-glass insulation; polyethylene vapor barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 5000 fpm.
 3. Temperature Range: Minus 10 to plus 175 deg F.
- D. Flexible Duct Clamps: Nylon strap, in sizes 3 through 18 inches to suit duct size.
- E. Flexible Elbow: UL listed for return air plenums, molded composite material, one-piece design to install over outside of flexible duct.

2.10 SPIN-IN FITTING

- A. Spin-in Fitting: Factory-fabricated assembly for making round take-off connections to rectangular ducts.
1. Galvanized sheet steel construction.
 2. Adjustable damper with locking quadrant.
 3. Insulation guard for use with internally lined duct.

2.11 VEHICLE EXHAUST DOOR PORT AND TUBING

- A. Manufacturers:
1. Car-Mon Products, Inc.
 2. Engwald Corp.
 3. DSP – MONOVENT
- B. Door ports shall be equal to Car-Mon #DPA-4 sized for 4-inch exhaust hose.
- C. Tubing assemblies shall be equal to 4" diameter Car-Mon #HTX or #CLX high temperature rated tubing, 15 feet long with clamping inlet and stainless steel door nozzle fitting.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts."
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- E. Install automatic control dampers where indicated. Coordinate damper installation requirements with Division 23 Section "Instrumentation and Control for HVAC".

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- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
 - 1. Provide concealed damper regulators for dampers located above hard ceilings and in other non-accessible locations.
 - G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Adjacent to motorized dampers, fire or fire/smoke dampers, providing access.
 - H. Install the following sizes for duct-mounting, rectangular access doors:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - I. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment."
 - J. Install fire/smoke dampers according to manufacturer's UL-approved written instructions.
 - K. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Locate flexible connectors below roof level for rooftop equipment unless indicated otherwise.
 - L. Connect air terminal units to supply ducts with maximum 24-inch lengths of flexible duct. Do not use flexible ducts to change directions.
 - M. Connect diffusers or light troffer boots to low pressure ducts with maximum 48-inch lengths of flexible duct clamped or strapped in place. Install sheetmetal elbow or flexible elbow at terminal connection to prevent duct crimping.
 - N. Bends in flexible ducts shall be made with not less than 1 duct diameter centerline radius. Do not compress ducts.
 - O. Connect flexible ducts to metal ducts with nylon draw straps.
- 3.2 ADJUSTING
- A. Adjust duct accessories for proper settings.
 - B. Adjust fire/smoke dampers for proper action.
 - C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

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3.3 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 233300

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SECTION 233301 - WALL LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fixed, extruded-aluminum louvers.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 PERFORMANCE REQUIREMENTS

- A. Air-Performance, Water-Penetration, Air-Leakage, and Wind-Driven Rain Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of metal finish required.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

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1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Louvers:
 - a. Acme Engineering & Mfg. Corp.
 - b. American Warming and Ventilating, Inc.
 - c. Arrow United Industries.
 - d. Cesco Products.
 - e. Construction Specialties, Inc.
 - f. Dowco Products Group; Safe-Air of Illinois, Inc.
 - g. Greenheck.
 - h. Industrial Louvers, Inc.
 - i. Louvers & Dampers, Inc.
 - j. Pottorff
 - k. Ruskin Company.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5.
- B. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.
- C. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

2.3 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing to produce uniform appearance.
- C. Fabricate frames, including integral sills and mullions, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Exterior flange, unless otherwise indicated
- D. Include supports, anchorages, and accessories required for complete assembly.

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2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver:
 - 1. Louver Depth: 4 inches
 - 2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch.
 - 3. Blades: Drainable type.
 - 4. Mullion Type: Hidden, with downspout.
 - 5. Performance Requirements:
 - a. Free Area: Not less than 8.5 sq. ft. for 48-inch- wide by 48-inch- high louver.
 - b. Point of Beginning Water Penetration: Not less than 870 fpm.
 - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area velocity.
 - 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
 - 7. Reference Manufacturer/Model: Ruskin ELF375DX.

2.5 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening.
- B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.
 - 2. Finish: Same finish as louver frame.
 - 3. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.
- D. Louver Screening for Aluminum Louvers:
 - 1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish louvers after assembly.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

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- B. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - 1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603, except with a minimum dry film thickness of 1.5 mils, medium gloss.
 - 2. Color: Match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Secure to framing with suitable fasteners.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 CLEANING

- A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

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- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 233301

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SECTION 233423 – HVAC POWER VENTILATORS

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. Utility set fans.
 - 2. Ceiling-Mounting ventilators.
 - 3. In-Line centrifugal fans.
 - 4. Propeller fans.
 - 5. Ceiling paddle fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
 - 5. Dampers, including housings.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. One copy of any manufacturer's installation and start up instructions, plus manufacturer's approved forms shall be provided to the Commissioning Authority at the time of equipment submittals.
- D. Maintenance Data: For power ventilators 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, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standards: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Acme Engineering & Mfg. Corp.
 2. Breidert Air Products
 3. Broan Mfg., Co., Inc.
 4. Carnes.
 5. Dayton (Paddle Fans Only).
 6. Loren Cook Company.
 7. Greenheck.
 8. Penn Ventilation.

2.2 CEILING-MOUNTING VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- 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: Powder-coated steel or stainless-steel louvered grille with flange on intake and thumb screw attachment to fan housing.

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- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

2.3 UTILITY SET FANS

- A. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
 - 1. Housing Discharge Arrangement: Adjustable to eight standard positions.
- C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
 - 1. Blade Materials: Steel or aluminum.
 - 2. Spark-Resistant Construction: AMCA 99.
- D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
- E. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9 L_{10} of 40,000 hours.
- F. Shaft Bearings: Grease-Lubricated, self-aligning, pillow-block-type ball or roller bearings with cast-iron housing.
 - 1. Ball-Bearing Rating Life: ABMA 9 L_{10} of 40,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L_{10} of 40,000 hours.
- G. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor: 1.5.
 - 2. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - 3. Belts: Oil resistant, nonsparking, nonstatic; matched sets for multiple belt drives.
 - 4. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.
- H. Accessories:
 - 1. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades and felt edges in steel frame installed on fan discharge.

2.4 IN-LINE CENTRIFUGAL FANS

- A. Description: In-line, centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- B. Housing: Bolted construction, minimum 18 gage sheet steel with integral duct collars; gasketed access doors.
- C. Fan Wheel: Aluminum, backward-inclined with cast aluminum hub; dynamically balanced.
- D. Direct-Driven Units: Motor mounted in housing and airstream.

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E. Belt-Driven Unit Drive Assembly:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings.
 - a. Ball-Bearing Rated Life: ABMA 9 L_{10} of 40,000 hours.
3. Shaft Bearings: Grease-Lubricated, self-aligning, pillow-block-type ball or roller bearings with cast-iron housing.
 - a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 40,000 hours.
 - b. Roller-Bearing Rating Life: ABMA 11, L_{10} of 40,000 hours.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Motor, bearings and drives isolated from exhaust airstream.

F. Accessories:

1. Insulated Housing: Glass fiber acoustical lining for housing interior.
2. Variable-Speed Controller: Factory-installed or field-installed for direct-driven motors where scheduled. Solid-state control to reduce speed from 100 percent to less than 50 percent.
3. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
4. Belt Guard: Factory-installed steel cover for drive assembly.
5. Backdraft Damper: Extruded aluminum construction, gravity operated, shipped loose for field installation.

2.5 PROPELLER FANS

- A. Description: Belt-driven or direct-driven propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.
- 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 Wheel: Replaceable, aluminum, airfoil blades fastened to hub; factory set pitch angle of blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 1. Service Factor Based on Fan Motor: 1.5
 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 3. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings.
 - a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 40,000 hours.
 4. Shaft Bearing: Grease-Lubricated, self-aligning, pillow-block-type ball or roller bearings with cast-iron housing.
 - a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 40,000 hours.
 - b. Roller-Bearing Rating Life: ABMA 11, L_{10} of 40,000 hours.
 5. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.

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6. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
7. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
8. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

F. Accessories:

1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Variable-Speed Controller: Factory-installed or field-installed for direct-driven motors where scheduled. Solid-state control to reduce speed from 100 percent to less than 50 percent.
5. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.6 CEILING PADDLE FANS

- A. Description: Industrial rated direct drive with permanently lubed ball bearing motor, suitable for 105-degree maximum ambient air temperature, moisture resistant. Provide steel down rod and mounting bracket as required for free rotation of fan blades.
- B. Fans: White epoxy finished steel or aluminum.
- C. Accessories: Wall mounted speed and reversing switch.

2.7 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment".

2.8 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."
- C. UL Standards: Power ventilators shall comply with UL 705; UL 762 for grease-laden air applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.

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- B. Install units with clearances for service and maintenance.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Coordinate electrical requirements with Division 26 – Electrical.
- D. Ground equipment.
- E. 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. Equipment Startup Checks:
 1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Verify lubrication for bearings and other moving parts.
 6. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 7. Shut unit down and reconnect automatic temperature-control operators.
 8. Remove and replace malfunctioning units and retest as specified above
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Start-up testing will be witnessed by the Commissioning Authority. One copy of all manufacturer's start up and testing forms shall be provided to the Commissioning Authority upon completion of the testing.

3.4 ADJUSTING

- A. Adjust belt tension.

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3.5 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 233423

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SECTION 233713 – DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, grilles, and continuous tubular fabric diffusers.
- B. Related Sections include the following:
 - 1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

- A. Product Data: For each product scheduled, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carnes.
 - 2. Krueger.
 - 3. Metal Industries, Inc.
 - 4. Nailor Industries
 - 5. Price Industries.
 - 6. Seiho.
 - 7. Titus.
 - 8. Tuttle & Bailey.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 233713

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SECTION 234100 – PARTICULATE AIR FILTRATION

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 factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.3 SUBMITTALS

- A. Product Data: Include dimensions; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Maintenance Data: For each type of filter and device to include in operation and maintenance manuals. Provide master filter schedule, listing quantity, size and type of filter for each air handling unit or terminal unit requiring filters.

1.4 DEFINITIONS

- A. MERV: Minimum efficiency reporting value (ASHRAE 52.2).

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 90A and NFPA 90B.
- B. ASHRAE Compliance: Comply with provisions of ASHRAE 52.1 and ASHRAE 52.2 for methods of testing and rating air-filter units.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide one complete set of each type of filter for each air handling unit or terminal unit requiring filters. Obtain signed receipt from Owner's representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Filters:
 - a. AAF International.
 - b. Airguard Industries, Inc.

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- c. Camfil/Farr
- d. Flanders Filters, Inc.
- e. Purolator Products.
- f. Research Products Corp.

2.2 EXTENDED-SURFACE, LOW-RESISTANCE, DISPOSABLE PANEL FILTERS

- A. Description: Factory-fabricated, dry, extended-surface filters with holding frames; UL Class 2 listed.
- B. Application:
 - 1. Direct-driven fan coil units with unit filter housings.
- C. Media: Reinforced, non-woven cotton/synthetic blend media formed into deep-V-shaped pleats and held by self-supporting wire grid.
- D. Media and Media-Grid Frame: Nonflammable, moisture-resistant beverage board with diagonal and horizontal support members on the upstream and downstream sides.
- E. Thickness: 1-inch.
- F. Performance:
 - 1. Average efficiency: 20% (ASHRAE 52.1)
 - 2. MERV: 6 (ASHRAE 52.2)
 - 3. Average arresstance: 85%
 - 4. Initial (clean) resistance: 0.14 inch wg. at 350 fpm.
 - 5. Recommended final (changeout) resistance: 0.35inch wg.
 - 6. Base of Design Manufacturer/Series: Camfil/Farr "20/20".

2.3 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

- A. Description: Factory-fabricated, dry, extended-surface filters with holding frames; UL Class 2 listed.
- B. Application:
 - 1. Indoor modular air handling unit.
- C. Media: Reinforced, non-woven cotton/synthetic blend media formed into deep-V-shaped pleats and held by self-supporting wire grid.
- D. Media and Media-Grid Frame: Nonflammable, moisture-resistant beverage board with diagonal and horizontal support members on the upstream and downstream sides.
- E. Thickness: 2-inch.
- F. Performance:
 - 1. Average efficiency: 25-30% (ASHRAE 52.1)
 - 2. MERV: 8 (ASHRAE 52.2)
 - 3. Average arresstance: 90-92%
 - 4. Initial (clean) resistance: 0.25-0.30 inch wg. at 500 fpm.
 - 5. Recommended final (changeout) resistance: 0.9 inch wg.

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6. Base of Design Manufacturer/Series: Camfil/Farr "Aeropleat IV+".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install filter frames according to manufacturer's written instructions.
- B. Position each filter unit with clearance for normal service and maintenance.
- C. Install filters in position to prevent passage of unfiltered air.
- D. Coordinate filter installations with duct and air-handling unit installations.
- E. Clean filter housings after completing system installation and install new filters in all air handling equipment prior to testing, adjusting and balancing.
- F. Where allowed, install filters in all air handling equipment used for temporary heating or air circulation. Filters shall be disposable type, not less than 25-30% efficiency and shall be inspected frequently during construction to prevent damage to equipment and accumulation of debris in duct systems. Air handling equipment shall not be operated without filters in place.

3.2 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 234100

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SECTION 235213 - ELECTRIC BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes packaged, factory-fabricated and -assembled electric boilers, trim, and accessories for generating hot water.

1.3 SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories.
- C. Wiring Diagrams: Power, signal, and control wiring.

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. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- C. NFPA Compliance: Design and fabricate boilers to comply with NFPA 70, "National Electrical Code," Article 424, Paragraphs G and H.
- D. UL Compliance: Test boilers for compliance with UL 834, "Heating, Water Supply, and Power Boilers--Electric." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleaver-Brooks; div. of Aqua-Chem, Inc.

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2. Fulton Boiler Works, Inc.
3. Lochinvar Corporation.

2.2 MANUFACTURED UNITS

- A. Description: Factory-fabricated, -assembled, and -tested electric boilers with trim and controls necessary to generate hot water.
- B. Pressure Vessel: Carbon-steel pressure vessel mounted on structural-steel base.
- C. Insulation: Minimum 4 inch thick, glass-fiber insulation.
- D. Jacket: Sheet metal casing with enamel protective finish and removable panels with snap-in or interlocking closures for access to pressure vessel.
- E. Heating Elements: Incoloy-sheathed, replaceable electric-resistance element, rated 20 kW maximum, with maximum.
- F. Mounting base to secure boiler to concrete base.

2.3 TRIM

- A. Aquastat Controllers: Operating auto-reset high limit.
- B. Safety Relief Valve: ASME rated.
- C. Pressure and Temperature Gage: Minimum 3-1/2-inch- (89-mm-) diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.
- D. Boiler Air Vent: Automatic.
- E. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end ball valve sized per requirements of authorities having jurisdiction.

2.4 CONTROLS

- A. Boiler operating controls shall include the following devices and features:
 1. Control transformer.
 2. Step controller.
 3. Recycling relay returns controller to off position after power failure.
 4. Multistage thermostat.
 5. Control circuit switch.
 6. Visual indication for each step.
 7. Supply-voltage indicator.
 8. Set-Point Adjust: Set points shall be adjustable.
 9. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control element sequence controller to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 200 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 110 deg F.

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- B. Safety Controls: To maintain safe operating conditions, safety controls limit boiler operation.
 - 1. High Cutoff: Manual reset stops boiler if operating conditions rise above set point or maximum boiler design temperature.
 - 2. Low-Water Cutoff Switch: Electronic probe shall prevent boiler operation on low water. Cutoff switch shall be manual reset type.

2.5 ELECTRICAL POWER

- A. Single-Point Field Power Connection: Factory-installed and -wired switches, transformers, and electrical devices necessary shall provide a single-point field power connection to boiler.
- B. Electrical Enclosures: NEMA 250, Type 1 enclosure with hinged door and key-locking handle.
- C. Install factory wiring outside of an enclosure in a metal raceway.
- D. Comply with NFPA 70.
 - 1. Electrical Circuits: 48 A, maximum.
- E. Connectors: Mechanical lugs bolted to copper bus bars or distribution blocks with pressure connectors.
- F. Fuses: NEMA FU 1, Class J or K5; 60 A, maximum.
- G. Contactors: 3-pole magnetic contactors, listed for 500,000 cycles at full load.
- H. Factory-wired internal control devices and heating elements.
 - 1. Wiring shall be numbered and color coded to match the wiring diagram.

2.6 SOURCE QUALITY CONTROL

- A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatic Test: Factory test assembled boiler including hydrostatic test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
 - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces, including required space for element removal, for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 BOILER INSTALLATION

- A. Equipment Mounting: Install boilers on cast-in-place concrete equipment base.
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct bases to withstand, without damage to equipment, seismic force required by code.
 3. Construct concrete bases 4 inches high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of boiler unless otherwise indicated or unless required for seismic anchor support.
 4. 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.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Connect hot-water piping to supply- and return-boiler tapings with shutoff valve and union or flange at each connection.
- D. Install piping from safety relief valves to nearest floor drain.
- E. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
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 installation and startup checks according to manufacturer's written instructions.
 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

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3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of water level and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 017900 "Demonstration and Training."

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 235213

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SECTION 237313 - MODULAR INDOOR AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes modular air-handling units with coils for indoor installations.
- B. Related Sections include the following:
 - 1. Division 23 Section "Particulate Air Filtration" for filter descriptions.

1.3 SUBMITTALS

- A. Product Data: For each type of modular indoor air-handling unit indicated. Include the following:
 - 1. Certified fan-performance curves with system operating conditions indicated.
 - 2. Motor ratings, electrical characteristics, and motor and fan accessories.
 - 3. Material gages and finishes.
 - 4. Dampers, including housings, linkages, and operators.
 - 5. Installed accessories.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain modular indoor air-handling units through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- B. Coordinate installation of equipment supports and roof penetrations.
- C. Coordinate size and location of structural-steel support members.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set for each modular indoor air-handling unit.
 - 2. Fan Belts: One set for each modular indoor air-handling unit fan.

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3. Gaskets: One set for each access door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carrier; Div. of United Technologies Corp.
 2. CES Group Inc.; Temtrol Division.
 3. Haakon Industries.
 4. Johnson MarCraft.
 5. McQuay International.
 6. Petra Engineering Industries.
 7. Scott Springfield Manufacturing.
 8. Trane Company (The).
 9. YORK International Corporation.

2.2 MANUFACTURED UNITS

- A. Modular indoor air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, condensate pans, mixing dampers, control devices, electrical devices, and accessories. Provide shipping splits complete with connection components for field assembly where required.

2.3 CABINET

- A. Materials: Complete structural frame with reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
 1. General: Casing deflection shall not exceed a 1:200 ratio when subject to an internal pressure of +/- 6-in. wg. Casing leakage rate shall be less than 1% at 6-in. wg. of nominal unit airflow or 50 CFM, whichever is greater. Factory witness leak testing and/or test reports shall be available upon request.
 2. Casing Construction: 2-inch double-wall.
 3. Exterior Casing: Galvanized steel.
 4. Interior Casing: Galvanized steel; solid.
 5. Unit Base: Structural steel channel, minimum 14 gage.
- B. Cabinet Insulation: Comply with NFPA 90A.
 1. Materials: Glass fiber insulation, 1.5 lb. density, ASTM C 1071, or spray injected foam.
 2. Thickness: 2 inches.
 3. Thermal Conductivity R: Minimum 12.5 BTU/hr-ft²-degF.
 4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
 5. Location: Encased between exterior and interior casings.
- C. Access Panels and Doors: Same materials and finishes as cabinet, complete with hinges, latches, handles, and gaskets. Inspection and access panels and doors shall be sized and located to allow periodic maintenance and inspections. Doors for fan sections to have viewing window. Provide access panels and doors in the following locations:
 1. Fan Section(s).

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2. Access Section.
3. Coil Section.
4. Damper Section.
5. Filter Section.

2.4 SUPPLY FAN SECTION

- A. Fan-Section Construction: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with vibration isolation.
- B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to make curved scroll housings with shaped cutoff, spun-metal inlet bell, and access doors or panels to allow entry to internal parts and components.
 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Performance Class: AMCA 99-2408, Class I.
 3. Horizontal Flanged Split Housing: Bolted construction.
 4. Airfoil Wheel Plenum (Plug) Fans: With steel cabinet. Fabricate without fan scroll and volute housing.
- C. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower. Fans with variable frequency drives shall be balanced for inverter duty operation over the entire range of fan operation (30% to 100% of RPM).
- D. Forward-Curved Fan Wheels: Black-enamel or galvanized-steel construction with inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow.
- E. Airfoil-Fan Wheels: Steel construction with smooth-curved inlet flange, heavy backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- F. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- G. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
 1. Ball-Bearing Rating Life: ABMA 9, L_{10} of 40,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L_{10} of 40,000 hours.
- H. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation and with 1.5 service factor based on fan motor.
 1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.

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2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, nonsparking, and nonstatic; matched for multiple belt drives.
4. Belt Guards: Fabricate to OSHA/SMACNA requirements.
5. Motor Mount: Adjustable for belt tensioning.

- I. Vibration Control: Install fans on open-spring vibration isolators having a minimum of 2-inch static deflection.

2.5 MOTORS

- A. General: Comply with requirements of Washington State Energy Code.

2.6 COILS

- A. Coil Sections: Common or individual, insulated, galvanized-steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils
- B. Water Coils: Self-draining coil fabricated according to ARI 410.
 1. Piping Connections: Threaded, on same end.
 2. Tubes: Copper.
 3. Fins: Aluminum.
 4. Fin and Tube Joint: Mechanical bond.
 5. Headers: Seamless copper tube with brazed joints, prime coated.
 6. Frames: Galvanized-steel channel frame.
 7. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.
 - a. Working-Pressure Ratings: 200 psig, 325 deg F.
 8. Source Quality Control: Test to 300 psig and to 200 psig underwater.

2.7 DAMPERS

- A. General: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.
- B. Low-Leakage, Outside-Air Dampers: Double-skin, airfoil-blade galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, with steel operating rods rotating in sintered bronze bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.
- C. Combination Filter and Mixing Box: Parallel-blade galvanized-steel dampers mechanically fastened to steel operating rod in reinforced, galvanized-steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously. Cabinet support members shall hold 2-inch-thick, pleated, flat permanent or throwaway filters. Provide hinged access panels or doors to allow removal of filters from both sides of unit.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install modular indoor air-handling units with the following vibration and seismic-control devices. Vibration and seismic-control devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Units with Internally Isolated Fans: Secure units to anchor bolts installed in concrete bases/floor.
 - 2. Floor-Mounted Units: Support on concrete bases/floor using neoprene pads. Secure units to anchor bolts installed in concrete bases.
- B. Arrange installation of units to provide access space around modular indoor air-handling units for service and maintenance.

3.3 CONNECTIONS

- A. Install piping adjacent to machine to allow service and maintenance.
- B. Connect piping to modular indoor air-handling units mounted on vibration isolators with flexible connectors.
- C. Hot-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve, union or flange, and flexible connector at each connection.
- D. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections for modular indoor air-handling units without fan internal vibration isolation.
- E. Electrical: Comply with applicable requirements in N.E.C. Sections for power wiring, switches, and motor controls.
- F. Ground equipment according to N.E.C. Section "Grounding and Bonding."
- G. 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.

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3.4 FIELD QUALITY CONTROL

- A. Field Service: Engage a service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
 - 2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 STARTUP SERVICE

- A. Engage a service representative to perform startup service.
- B. Final Checks before Startup: Perform the following:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 6. Set outside- and return-air mixing dampers to minimum outside-air setting.
 - 7. Install clean filters.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- C. Starting procedures for modular indoor air-handling units include the following:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
 - 2. Measure and record motor electrical values for voltage and amperage.
 - 3. Manually operate dampers from fully closed to fully open position and record fan performance.
- D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for modular indoor air-handling system testing, adjusting, and balancing.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

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3.7 CLEANING

- A. Clean modular indoor air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing modular indoor air-handling and air-distribution systems, clean filter housings and install new filters.

3.8 DEMONSTRATION

- A. Engage a service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular indoor air-handling units

3.9 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 237313

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SECTION 238126 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Ducted Split-Systems: This Section includes split-system heating and air-conditioning units consisting of separate indoor ducted fan coil and outdoor heat pump compressor-condenser components.
- B. Ductless Split-Systems: This Section includes ductless split-system heat pumps with exposed indoor fan coil and outdoor compressor-condenser components.

1.3 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 split-system air-conditioning units to include in operation and maintenance manuals.
- D. Warranties: Special warranties specified in this Section.

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.

1.5 COORDINATION

- A. Coordinate size, location, and connection details with equipment supports.

1.6 WARRANTY

- A. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: One year parts, 5-years compressor from date of substantial completion.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier; Div. of United Technologies Corp.
 2. Daikin
 3. Lennox
 4. Mitsubishi
 5. Rheem/Ruud
 6. Sanyo
 7. Trane

2.2 AIR-COOLED HEAT PUMP, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor. R-410A refrigerant.
1. Compressor Type: Scroll.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Fan: Aluminum-propeller type, directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Kit: Permits operation down to -20 deg F.

2.3 DUCTED FAN-COIL UNITS

- A. Description: Factory-packaged and -tested units.
- B. Coil Section Insulation: 1/2-inch thick coated glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
- C. Chassis: Galvanized steel where exposed to moisture, with removable access panels.
- D. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

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- E. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and brazed joints at fittings. Comply with ARI 210/240, and leak test to minimum 450 psig for a minimum 300-psig working pressure. Include thermal expansion valve.
 - 1. Refrigerant and Oil: R-410A.
- F. Hot Water Duct Coil: Slip-in or flanged frame, copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.
- G. Direct-Drive Fans: Double width, forward curved, centrifugal; with permanently lubricated, multi-speed motor resiliently mounted in the fan inlet, factory-mounted and wired manual fan speed selector switch with OFF position. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
- H. Control devices and operational sequence are specified in Division 23 Sections "Automatic Temperature Controls" and "Sequence of Operation."

2.4 INDOOR WALL-MOUNTED DUCT-FREE UNITS

- A. General:
 - 1. Indoor, direct-expansion, wall-mounted fan coil. Unit shall be complete with cooling/heating coil, fan, fan motor, piping connections, electrical controls, microprocessor control system, and integral temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.
- B. Unit Cabinet:
 - 1. Cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.
- C. Fans:
 - 1. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard.
 - 2. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.
- D. Coil:
 - 1. Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.
- E. Motors:
 - 1. Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 3-speed.
- F. Controls:
 - 1. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62 deg F to 84 deg F

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2. The unit shall have the following functions as a minimum:
 - a. An automatic restart after power failure at the same operating conditions as at failure.
 - b. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
 - c. Temperature-sensing controls shall sense return air temperature.
 - d. Indoor coil freeze protection.
 - e. Wireless infrared remote control to enter set points and operating conditions.
 - f. Automatic air sweep control to provide on or off activation of air sweep louvers.
 - g. Dehumidification made shall provide increased latent removal capability by modulating system operation and set point temperature.
 - h. Fan-only operation to provide room air circulation when no cooling is required.
 - i. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
 - j. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.
 - k. Automatic heating-to-cooling changeover in heat pump mode. Control shall include deadband to prevent rapid mode cycling between heating and cooling.
 - l. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.

G. Filters:

1. Unit shall have filter track with factory-supplied cleanable filters.

H. Operating Characteristics:

1. The system shall have a minimum listed SEER (seasonal energy efficiency ratio) of 13 at ARI conditions, and a minimum HSPF of 7.7.

I. Refrigerant Lines:

1. All units should have refrigerant lines that can be oriented to connect from the left, right or back of unit. Both refrigerant lines need to be insulated.

J. Special Features (Field Installed):

1. Condensate Pump:
 - a. The condensate pump shall remove condensate from the drain pan when gravity drainage cannot be used. Pump shall be designed for quiet operation. Pump shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. A liquid level sensor in the reservoir shall stop cooling operation if the liquid level in the reservoir is unacceptable.

2.5 DUCTLESS SPLIT HORIZONTAL DISCHARGE OUTDOOR UNITS

A. General:

1. Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the compressor.

B. Unit Cabinet:

1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside.
2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.

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3. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
- C. Fans:
1. Outdoor fans shall be direct-drive propeller type, and shall discharge air horizontally. Fans shall draw air through the outdoor coil.
 2. Outdoor fan motors shall be totally-enclosed, single phase motors with class B insulation and permanently-lubricated ball bearings. Motor shall be protected by internal thermal overload protection.
 3. Shaft shall have inherent corrosion resistance.
 4. Fan blades shall be non-metallic and shall be statically and dynamically balanced.
 5. Outdoor fan opening shall be equipped with PVC metal/mesh coated protection grille over fan.
- D. Compressor:
1. Compressor shall be fully hermetic rotary type.
 2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current.
 3. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.
 4. Compressor assembly shall be installed on rubber vibration isolators.
 5. Compressors shall be single phase.
- E. Outdoor Coil:
1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
- F. Refrigeration Components:
1. Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, reversing valve.
- G. Controls and Safeties:
1. Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
 - a. Controls:
 - 1) A time delay control sequence is provided standard through the fan coil board.
 - 2) Automatic outdoor-fan motor protection.
 - b. Safeties:
 - 1) System diagnostics.
 - 2) Compressor motor current and temperature overload protection.
 - 3) Outdoor fan failure protection.
- H. Special Features (Field Installed):
1. Low-Ambient Kit: Control shall regulate fan-motor cycles in response to saturated condensing temperature of the unit. The control shall be capable of maintaining a condensing temperature of 100 deg F +/- 10 deg F with outdoor temperatures to -20 deg F. Installation of kit shall not require changing the outdoor fan motor.
 2. Crankcase Heater.
 3. Wind baffle (field fabricated).

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- D. Install roof-mounted compressor-condenser components on equipment supports. Anchor units to supports with removable, cadmium-plated fasteners.
- E. Install compressor-condenser components on rubber pads with a minimum static deflection of 0.25 inch.
- F. Connect refrigerant piping to indoor and outdoor sections; maintain required access to unit. Install furnished field-mounted accessories.

3.2 CONNECTIONS

- A. Connect condensate drain pans using Type M copper tubing of same size as drain pan outlet connection. Extend to nearest equipment or floor drain. Construct p-trap of depth and configuration as required for unit static pressure at connection to drain pan.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 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. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

- A. Engage a service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

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3.5 DEMONSTRATION

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

3.6 MECHANICAL SYSTEMS COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 230800 – Commissioning of HVAC. The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION 238126

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SECTION 238230 - WALL AND CEILING HEATERS

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 wall and ceiling heaters with propeller fans and electric heating elements.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Operation and Maintenance Data: For wall and ceiling heaters to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berko Electric Heating; a division of 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. Raywall.
 - 8. 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.

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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.
- 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. Controls: Unit-mounted thermostat.
- G. 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 wall and ceiling 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 wall and ceiling heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly.
- B. Install wall and ceiling heaters to comply with NFPA 90A.

3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "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 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 238230

SECTION 260500 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 01 Section "General Commissioning Requirements".

1.2 SCOPE OF WORK – GENERAL

- A. This section specifies general requirements for electrical installations and includes requirements common to more than one section of Divisions 26, 27, and 28. It expands and supplements the requirements specified in sections of Division 01.
- B. Provide materials, labor, transportation, tools, permits, facilities, fees, inspections, utilities and incidentals necessary for the complete installation of electrical work indicated and described in the Contract Documents.
- C. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified under this section of work or work specified in other sections, provide material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned or not.
- D. All work shown and/or specified shall be completely installed and connected in a first class and workmanlike manner and shall be complete in all details.
- E. All work shall be done by technicians properly qualified to perform the work required.
- F. Workmanship shall comply with the National Electrical Installation Standards (NEIS), published by the National Electrical Contractors Association (NECA).
- G. All work shall be done in accordance with manufacturer's instructions and recommendations. Except where the drawings or these specifications specifically indicate other instructions.

1.3 SEQUENCE OF WORK

- A. Conduct work in sequence to provide least possible interference to the activities of the Owner, and to permit orderly transfer of activities and equipment to completed areas.
- B. Work shall be substantially complete by the dates listed in Division 01 Section "Summary".

1.4 ALTERNATES

- A. Refer to Division 01 Section "Alternates" for description of alternates. Review Contract Documents for additional information.

1.5 DEFINITIONS

- A. Provide: Furnish and install complete and ready for intended use.
- B. Indicated: Indicated on drawings.
- C. Noted: Noted on Drawings or in Specifications.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- E. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical and electrical equipment rooms.
- F. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- G. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants and hidden from sight. Examples include above ceilings, within finished walls and in chases or furred spaces.
- H. 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 and utility vaults.

1.6 CODES AND STANDARDS

- A. Code Compliance: Comply with most current adopted edition of following:
 - 1. NFPA 5000 – Building Construction and Safety Code.
 - 2. Uniform Mechanical Code (UMC), Standards and Amendments.
 - 3. Uniform Plumbing Code (UPC), Standards and Amendments.
 - 4. National Fire Protection Association (NFPA).
 - 5. National Electrical Code (NEC); NFPA 70.
 - 6. American with Disabilities Act (ADA).
 - 7. Applicable State and local codes, laws and ordinances.
- B. Standards and Regulations Compliance: Comply with most current adopted edition of following:
 - 1. BICSI Telecommunications Distribution Methods Manual (TDMM) 10TH Addition, Standards/Practices and Amendments.
 - 2. Institute of Electrical and Electronics Engineers (IEEE), Standards/Practices and Amendments.
 - 3. ANSI/TIA/EIA-568-B, Standards and Amendments.
 - 4. ANSI/TIA/EIA-569-B, Standards and Amendments.
 - 5. ANSI/TIA/EIA-606-A, Standards and Amendments.
 - 6. ANSI J-STD-607-A, Standards and Amendments.
- C. Comply with Contract Document requirements which exceed minimum code and standards requirements.

1.7 SAFETY OF PERSONS AND PROPERTY

- A. Comply with applicable laws, ordinances, rules and regulations of any public authority for the safety of persons and property, including requirements of the Washington Industrial Safety and Health Administration (WISHA) and/or the Occupational Safety and Health Act (OSHA) and Division 01, General and Supplementary Conditions.

1.8 PERMITS AND FEES

- A. Obtain and pay for required permits and fees necessary to fully complete work included in the Contract Documents.
- B. Include all required utility company fees or charges for electrical power service or revisions to existing service.

1.9 INTENT AND INTERPRETATION

- A. Drawings and Specifications supplement each other and any details contained in one and not the other shall be included as if contained in both. Items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation shall be included.
- B. Drawings are partly diagrammatic and do not necessarily show exact location of new equipment, conduits, and existing utilities, unless specifically dimensioned. Size and location of equipment are drawn to scale where possible, however some graphic symbols may be distorted dimensionally to obtain clarity in representation.
- C. Approximate location of each item is indicated on the drawings. These drawings are not intended to give complete and exact details in regard to location. Exact locations are to be determined by actual measurements at the building.
- D. Riser and other diagrams are schematic only and do not necessarily show the physical arrangement of equipment. They shall not be used for obtaining quantities or lineal runs of conduit and conductors.
- E. Drawings generally indicate required minimum allowable size, quantity and type of conductors and points of termination of conduits. Routing or total number of conduits required for circuits are not indicated. Provide additional conduits as required to complete installation for specific equipment furnished.
- F. Receptacles, switches and other devices shall be located symmetrically with Architectural elements and coordinated with equipment or devices furnished in other Sections, or by the Owner. Devices shall be centered on windows, wall spaces, or other items, unless specifically dimensioned otherwise.
- G. Electrical drawings shall serve as working drawings for Division 26 and 27 work. Refer to Architectural, Structural, Civil, Landscape, Security and Mechanical drawings for additional detail affecting the installation of work. Architectural drawings shall take precedence over the Electrical drawings if any dimensional discrepancies exist.

1.10 SUBMITTAL OF EQUIPMENT FOR APPROVAL

- A. Refer to Division 01 requirements for submittal definitions, requirements and procedures. Additional requirements are listed below.
- B. Shop drawings, catalog information, and material schedules shall be submitted for approval of materials and equipment prior to ordering. A list of submittals required will be supplied by the Engineer.
- C. If not shown on plans, contractor to provide riser and interconnecting wiring diagrams for the following systems:
 - 1. Fire Alarm Notification and Detection (See Division 27)
 - 2. Access Control (See Division 28)
 - 3. Video Surveillance (See Division 28)
 - 4. Security (See Division 28)
 - 5. Telecommunication (See Division 27)
- D. Submittal data shall clearly identify electrical components, devices and accessories as listed and labeled by Underwriter's Laboratory, or other testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Clearly mark submittals as to which items, options, colors, model, etc. to be furnished.
- F. Submittals not meeting the following requirements will be returned for revision:
 - 1. Provide a cover page for each item or group of items. Cover page shall provide a 3" x 5" space for Engineer's review stamp.
 - 2. Each cover page must be clearly identified with the project name, specification number and paragraph number.
 - 3. Submittal package must be accompanied by an itemized index listing specification section, paragraph number, item and manufacturer; larger projects will be index tabbed by specification section with index for each section.

1.11 SCHEDULE OF VALUES

- A. Furnish to the Engineer, a breakdown of the Contract for work in Divisions 26, 27, and 28 within 30 days of Notice to Proceed.
- B. The breakdown shall list cost for materials and labor as follows:
 - 1. Miscellaneous Overhead Expenses.
 - 2. Mobilization. (Maximum of 5%)
 - 3. Permits
 - 4. Utility Company Connection Fees
 - 5. Primary Service Materials
 - 6. Primary Service Labor
 - 7. Secondary Service Material
 - 8. Secondary Service Labor
 - 9. Panelboards
 - 10. Panelboard Labor
 - 11. Feeder Conduit and Conductors Labor

12. Feeder Conduit and Conductors Materials
13. Branch Circuit Conduit, Conductors and Devices Material
14. Branch Circuit Conduit, Conductors and Devices Labor
15. Interior Lighting Fixtures.
16. Interior Lighting Fixture Labor
17. Site Lighting Fixtures
18. Site Lighting Fixtures Labor
19. Fire Alarm and Detection System
20. Fire Alarm and Detection System Labor
21. Communication Systems
22. Communication Systems Labor
23. Security System
24. Security System Labor
25. Equipment Connections.
26. Project Closeout (Minimum of 5%):
 - a. O & M Manuals
 - b. Record Documents
 - c. Owner Training

1.12 GUARANTEE

- A. Guarantee satisfactory operation of material and equipment installed under Divisions 26, 27 , and 28. Repair or replace any defective materials, equipment, or workmanship which may show itself within one year from date of Substantial Completion.
 1. Incandescent lamps shall have two month warranty period only.
 2. Specific requirements in individual Division 26, 27, and 28 Sections.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials used under this Contract, unless specifically noted otherwise, shall be new and of the latest and most current model line produced by the manufacturer. Outdated "new" equipment is not acceptable.
- B. Electrical components, devices, and accessories to 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.

2.2 EQUIPMENT AND MATERIAL SUBSTITUTIONS

- A. Throughout these Contract Documents, various materials, equipment, apparatus, etc., are specified by manufacturer, brand name, type or catalog number. Such designation is to establish standards of desired quality and construction and shall be the basis of the bid.
- B. Where more than one manufacturer is listed, and only one manufacturer's catalog number is indicated, that standard of quality and construction shall be maintained by materials supplied by other manufacturer(s).

- C. Substitutions of equipment or materials shall be made only with written prior approval. Prior approval requests must be received at least ten (10) days prior to bid date unless otherwise instructed. Refer to Division 01 Section "Product Requirements" for procedures in requesting substitutions.
- D. Acceptance of substitution request signifies manufacturer recognition only. No attempt has been made to check each item as to special features, capacities, or physical dimensions required by this project. Verify requirements before submitting for approval. Acceptance of exact features, sizes, capacities, etc., all of which must meet or exceed design requirements will be determined when submitted during the construction phase.
- E. The Contractor shall bear full responsibility for substituted equipment and materials, including, but not limited to:
 - 1. Costs.
 - 2. Available space requirements.
 - 3. Effect on other trades.
 - 4. Changes in electrical requirements
 - 5. Changes in structural requirements.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Refer to Division 01 Section "Project Management And Coordination".
- B. Coordinate available space for equipment and systems with other trades. Refer to Architectural, Structural and Mechanical Drawings for additional building details necessary for coordination.
- C. Cutting, patching, wiring, finishing or any other work required for relocation of work installed due to interferences between works of the various trades will be at no additional cost to the Owner.

3.2 CUTTING AND PATCHING

- A. Comply with Division 01 Section "Execution" for general requirements for cutting and patching.
- B. Do all cutting, drilling and patching that must be done in order that work is properly installed. All work of this nature is subject to the following conditions:
 - 1. All disturbed construction or finish must be made good.
 - 2. Structural work shall not be disturbed, except on approval of Architect.
 - 3. In general, cutting through floors, walls and partitions is to be avoided and only where absolutely necessary will same be permitted. When necessary, it shall be done in a careful manner and the opening filled about conduits as directed by the Architect. Holes through concrete or masonry shall be made only with a core drill. Obtain permission from Architect for each individual opening.
 - 4. All masonry or other finish damaged or cut into during the installation of this work must be replaced or repaired with materials of like kind and quality as the original materials by skilled labor, experienced in that particular building trade.

3.3 CLEANUP

- A. At the time of final cleanup, all fixtures and equipment, new or existing, shall be thoroughly cleaned and left in condition for use. All debris and unused materials shall be removed from the construction site, leaving the premises in a clean condition.
- B. Site shall be kept clean on a day-today basis.

3.4 WARNING TAPE

- A. 5 mil plastic tape, at least 4" wide, with block lettering of a contrasting color at least 2" high, indicating the type of service at intervals not to exceed 5' along its length. The tape shall include 1 mil minimum metallic foil core or backing to facilitate locating.

3.5 SLEEVES

- A. Sleeves: EMT conduit, with insulated throat bushings for each end.
- B. Provide sleeves where required, sized as noted on the Contract Documents. Where not noted, sleeve sizing shall be determined by the type and quantity of cable to be routed through the sleeve per TIA/EIA 569A cable capacity standards, plus an additional 100% for future expansion.
- C. Provide roto-hammering or core drilling where required for installation.
- D. Seal between sleeve and wall or floor in which the sleeve is installed. Firestop penetration to restore wall or floor to pre-penetration fire-rating.

3.6 PAINTING

- A. Paint all exposed conduits, raceways, multi-outlet assemblies and panelboard trim as directed by Architect.
- B. Comply with Division 09 Section "Interior Painting" requirements for painting.

3.7 TESTS

- A. All work shall be complete in every respect and shall be tested and approved satisfactory to the Architect and in accordance with the local, state and federal regulations governing the installation.
- B. Be responsible for making any and all tests necessary to insure against concealment of defective materials and/or workmanship.
- C. Determine, by test, that all wiring and connections are free from shorts between wires and shorts to ground and that all circuits have proper continuity.
- D. All defects shall be corrected and retested before installation of fixtures and equipment.

- E. All miscellaneous systems shall be tested for conformity to specifications and for proper operation. Provide certification and/or documentation as described in individual Division 26, 27, and 28 Sections. Typical tests shall include outlet polarity, insulation resistance, large circuit breaker tests, surge suppression systems, phase relationships and load balance.

3.8 MANUFACTURER'S INSTRUCTIONS

- A. Furnish proper equipment and/or materials required for installation as intended by the manufacturer, for all work described under Division 26, 27, and 28. If needed for proper installation or operation, request advice and supervisory assistance from the representative of the specific manufacturer. Manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufactured materials or equipment, unless otherwise indicated. Promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's instructions before proceeding with the work.

3.9 SEISMIC RESTRAINTS

- A. Equipment, conduits, raceways, cable tray, etc. shall be provided with seismic restraints in accordance with Code requirements.

3.10 EXAMINATION OF SITE

- A. Visit site of proposed work and become familiar with conditions affecting work. Verify measurements at the building before beginning work.

3.11 SITE UTILITY SERVICES

- A. Where applicable, make connections to temporary electrical service immediately so as to provide the use of this service by other trades. Comply with Division 01 Section "Temporary Facilities and Controls" requirements.

3.12 EXISTING UTILITIES

- A. Locations of existing concealed electrical utilities and connection points have been indicated as closely as possible from available information. Assume that such connection points are within a 10-foot (10') radius of indicated locations. Where connection points are not within this radius, contact the Architect for a decision before proceeding.

3.13 LAYING OUT WORK

- A. Locations of equipment and devices, as shown on the drawings, are approximate unless dimensioned. Exact locations of such items shall be determined from the Construction Drawings. Verify physical dimensions of each component of electrical equipment, to fit available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordinate equipment to available space and access routes through construction. Offsets in conduits required for proper system installation shall be provided at no additional cost to Owner.

3.14 REPLACEMENT OF PAVING AND CONCRETE

- A. Existing sidewalks, concrete paving, curbs, or asphalt paving removed or damaged during period of installation or as a result thereof, shall be replaced with like material in a manner as directed by and to the satisfaction of the Architect.

3.15 OPENINGS IN CONDUITS

- A. Cap or seal temporary openings in conduits or raceways during construction. Remove caps or seals for final connections.

3.16 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- C. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

3.17 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate location of concealed equipment and devices requiring access with location of access panels and doors. Allow ample space for removal of parts that require replacement or servicing.
- B. Access Doors: Prime coated 14 gauge steel, and flush, with screwdriver operated cam lock; frame to accommodate construction type. Access doors shall be manufactured by Acudor, Elmdor or approved equivalent. See Division 08 Section "Access Doors and Frames."
- C. Access doors shall be a minimum size of 24" square and compatible with the surface in which they are installed. Access door fire rating shall be equivalent to the wall, ceiling or floor they are installed in.

3.18 CONCRETE BASES

- A. Concrete forms and Reinforcement Materials as specified in Division 03:
 1. Forms: 2-1/2 inch minimum height, 3/4 inch chamfered edge at top of form.
 2. Reinforcement 6x6x10/10 welded fabric
- B. Concrete: 3000-psi, 28-day compressive strength as specified in Division 03.

3.19 EXCAVATING AND BACKFILLING

- A. Provide all necessary excavation, backfill, and related work in compliance with requirements of the General Specifications.
- B. Dig trenches to the uniform width required for the particular item to be installed and sufficiently wide to provide ample working room
- C. Where rock is encountered, carry the excavation 6 inches below the noted elevation, and backfill with 6 inch layer of sand prior to installing raceway.
- D. Grade bottom of trenches as indicated to provide solid bearing for the entire body of the raceway.
- E. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings. Place concrete to the level of the bottom of the adjacent footings.
- F. Do not backfill trenches until inspections have been made and backfilling authorized by the Architect. Use care in backfilling to avoid damage to or displacement of the raceway systems.
- G. Exercise extreme care while excavating in the area of existing utilities. Check carefully for locations of all possible utilities, whether shown on the drawings or not, and establish the location of all cutoff valves and switches for ready shut-off in case of an emergency. Assume complete responsibility for all damage to any utility caused by excavation, as well as damage to personal property and property caused by said damaged utility.
- H. Refinishing of streets, walks, paved areas, lawns, curbs, and fences removed or damaged by the excavation shall be done to the satisfaction of the Architect.

END OF SECTION 260500

SECTION 260505 – ELECTRICAL PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 01 Section “Submittal Procedures”.
 - 2. Division 01 Section “Closeout Procedures”.

1.2 SCOPE OF WORK - GENERAL

- A. This section specifies procedural requirements for electrical installations project closeout, including but not limited to:
 - 1. Project Record Document submittal.
 - 2. Operation and Maintenance Manual submittal.
 - 3. Operation and Maintenance Instruction and Training.
 - 4. Electrical Equipment and Systems Start-Up.
 - 5. Final Cleaning.
 - 6. Training Session Agenda.

1.3 PROJECT RECORD DOCUMENTS

- A. Record differences between electrical Work as installed and as shown in Contract Drawings on a set of dedicated electrical “as-built” plans. Plans to be obtained from the Architect. Return the finished plans to the Architect at completion of the project. Notations made on drawings shall be neat and legible using red ink only. Mistakes or corrections shall be crossed out and the correction made next to it. Comply with Division 01 Section requirements.
- B. Hard copy record drawings shall be converted to electronic AutoCAD 2010 (or later) format and saved on to CD-Rom. If Contractor can not provide this service, L&S Engineering shall be hired to perform conversion.
- C. Mark drawings to indicate the following:
 - 1. Revisions to conduits and conductors; size and location both exterior and interior.
 - 2. Revisions to branch circuiting.
 - 3. Revisions to device and outlet location and/or height.
 - 4. Revisions to lighting fixture locations.
 - 5. Concealed equipment and/or devices.
 - 6. Installed location of all underground site utilities including but not limited power, telecommunication, and future conduit raceways.
- D. Revise equipment and fixture schedules on the plans to indicate actual installed manufacturer and model numbers.
- E. Mark specifications to indicate change orders; actual equipment and materials used.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Prepare and submit Operation and Maintenance (O&M) Manuals for electrical systems provided. Comply with Division 01 Section requirements.
- B. Manual binder shall have permanent lettering of a contrasting color.
- C. Information to be included on the binder cover is as follows:

ELECTRICAL
OPERATION AND MAINTENANCE
MANUAL

Grant County Landfill
Ephrata, WA.
2010

OWNER:	Grant County Public Works Department
ARCHITECT:	Zeck Butler Architects
ELECTRICAL ENGINEER:	L&S Engineering Associates, Inc.
GENERAL CONTRACTOR:	(NAME)
ELECTRICAL CONTRACTOR:	(NAME)

- 1. The spine shall be lettered as follows:

ELECTRICAL O & M MANUAL 2010
Grant County Landfill

- D. Provide master index at beginning of Manual showing sections and items included. Use plastic tab indexes for sections of Manual.
- E. Cover section: List name, address, and phone number of Project Architect, General Contractor, Electrical Engineer, Electrical Contractor and all Electrical Sub-Contractors. Provide a list of equipment suppliers with address and phone number.
- F. Provide a separate section for each Section of the Specifications. Provide index for each section listing equipment included. Include all items specified.
- G. Include descriptive literature of each manufactured item (catalog cut sheets, etc). Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined. Data sheets shall be originals or clean copies of originals. Copies of faxes are not acceptable.
- H. Include copies of approved submittals or shop drawings for all items requiring submittal.

- I. One (1) copy of the O&M Manual shall be submitted for review and approval by the Design Engineer. After approval, submit three (3) copies of the manual to the Architect for approval, unless otherwise directed by Division 01 Section requirements.
- J. Information to be included in O&M Manual:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping shut-down, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Sequence of operation for each installed system.
 - 5. Itemized listing of lamp type and source for all installed lighting fixtures.
 - 6. Test records and certifications.
 - 7. Equipment start-up reports.
 - 8. Warranty information and letters of guarantee.
 - 9. Instruction period checklist for each equipment item.
- K. Complete O&M Manual shall be available for use by Owner's representatives during instruction and training sessions.
- L. Provide electronic files of approved O&M Manual. Comply with requirements of Division 01 Section "Operation and Maintenance Data".

1.5 OPERATION AND MAINTENANCE INSTRUCTION AND TRAINING

- A. Instruct Owner's Representative(s) in the Operation and Maintenance procedures described in Operation and Maintenance Manual. Comply with Division 01 Section requirements.
- B. Enlist services of qualified personnel, including each sub-trade and factory trained specialists for each major piece of equipment, to attend training sessions and provide operation and maintenance instructions.
- C. All electrical systems shall be properly functioning prior to instruction period.

PART 2 - EXECUTION

2.1 ELECTRICAL EQUIPMENT AND SYSTEMS START-UP

- A. Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service and demonstrate and train Owner's maintenance personnel.
- B. Include certification of factory-authorized representative status as part of equipment submittal from manufacturer.
- C. Include written start-up reports with test data for equipment in Operation and Maintenance Manual.

DIVISION 26 - ELECTRICAL

D. Required Equipment items shall include the following: Section 283111.

2.2 FINAL CLEANING

A. At time of final cleanup, clean all lighting fixtures, devices and equipment and leave in condition for use intended. Vacuum cabinet interiors of panelboards, control panels, mechanical units, etc. to remove all construction debris.

END OF SECTION 260505

SECTION 260519 - WIRE AND CABLE

PART 1 - GENERAL

1.1 PROVISIONS

- A. A complete system of wires shall be installed in the raceway system.
- B. All wiring shall be copper unless specifically noted otherwise.
- C. All conduit and electrical power required for the fire alarm system shall be furnished and installed by the Electrical Contractor as part of the overall Division 26 Work.
- D. The Electrical Contractor, as part of the overall Division 26 work, shall furnish and install all wiring for the supply power and circuits required for the special systems as listed above. Such wiring shall include all receptacles, terminations and over-current protection as required for complete circuit installation.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 1 apply to work specified in each section of this Division 26, 27, 28.
- B. See Sections 013513, 260500, 260533, and 283111.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts. Submit parts replacement/ordering information as part of O & M Manuals.
- B. All submittals shall be made in accordance with requirements of Section 260500 and Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All wiring shall be copper unless specifically noted otherwise, and shall be rated at 600 volts.
- B. Wire sizes 12AWG and 10AWG shall be solid, type THHN/THWN. Wire sizes 8 and larger shall be stranded, type THHN/THWN or sizes 4 and larger may be type XHHW. Minimum wire size shall be 12 AWG, unless noted otherwise.
 - 1. Exceptions: see Section 283111 for Fire alarm System wire and cable requirements.
- C. All wire shall be marked with gauge and insulation type on 24" centers, and color coded as required by the N.E.C.

- D. All conductors shall have phase and voltage identified by colored insulation, or tape or paint at both ends as follows:

	<u>120/208</u>	<u>277/480</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Grounding	Green or green tracer	Green or green tracer

- E. All wire and cable shall be brought to the job in the original containers bearing the U.L. label.
- F. Molded connectors with metal thread-on core shall be used for splicing 12 and 10 wire. Stranded cables shall be connected to lugs using mechanical connectors, and shall be wrapped with electrical tape to a thickness equal to the wire insulation.

2.2 ACCEPTABLE MANUFACTURERS

- A. Wire and cable shall be as manufactured by Rome, Southwire, Okonite, or Excell.
- B. Molded connectors shall be as manufactured by Panduit, 3M or Buchanan.
- C. Mechanical connectors shall be manufactured by Burndy, O.Z./Gedney Co., or Thomas & Betts.
- D. Tape shall be manufactured by 3M.
- E. Substitutions may be considered only when submitted in conformance with Section 260510.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wires shall be pulled in such a manner as to avoid kinking or abrasion to the insulation. Use only approved lubricants which do not deteriorate conductors or insulation. Oil or grease shall not be used to lubricate wires.
- B. Make sure that all conduit fittings have insulated bushings in place before pulling wires. If it is found that the insulating bushings are not in place before pulling wire, the wire will be removed and replaced with new at the contractors' expense.
- C. Where more than three current carrying conductors are installed in a single raceway, the minimum wire size shall be increased to comply with NEC Table 310-16, Note 8.
- D. Where the distance from the overcurrent device to the first outlet exceeds 100 feet, the minimum wire size shall be #10 AWG.
- E. All receptacle circuits associated with computer outlets shall have separate neutrals. No shared neutrals will be allowed. Neutral conductor shall be considered as "current-carrying" for the purpose of applying NEC Table 310-16, Note 8, above.
- F. Provide separate equipment ground conductor full length of all raceways. This conductor is not shown on the drawings and is in addition to the conductors shown.

- G. Except where conductor sizes are indicated on the drawings, the following schedule, listing minimum conductor size, shall be adhered to:

CIRCUIT OVERCURRENT	
DEVICE RATING	CONDUCTOR SIZE
20 amperes or less	12
30 amperes	10
40 amperes	8
50 amperes	6
60 amperes	4
70 amperes	4
80 amperes	3
90 amperes	2
100 amperes	1

- H. For paralleled conductors, lengths of the conductors shall be identical and one conductor for each phase and neutral shall be run in each conduit.

END OF SECTION 260519

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 PROVISIONS

- A. Provide grounding for the entire electrical system as required in Article 250 of the N.E.C., and as specified herein.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26.
- B. See Sections 260500, 260519, 262213, 262416 and 262417.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts. Submit parts replacement/ordering information as part of O & M Manuals.
- B. All submittals shall be made in accordance with requirements of Section 260500 and Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ground Rods: Copperweld 3/4" x 10'-0" or as required.
- B. Ground Clamps: Burndy Type NT.
- C. Compression Grounding: Burndy Hyground Irreversible Compression Grounding System, Thomas & Betts EZ Ground Compression Connectors, or approved equal.
- D. All conductors shall be copper.
- E. Ground Bar: 12 inch long, 4 inch wide, 1/4 inch thick, extruded copper bar with two insulated supports.
 - 1. Bar shall be drilled to accept standard 2-hole lugs.
 - 2. Bar shall have wire clamp connectors and be capable of connecting a minimum of #6 AWG solid conductors.

2.2 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers shall be as listed above.
- B. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The following are specifically included as requiring grounding:
1. Electric service, equipment, and enclosures.
 2. All raceways.
 3. Neutral conductor on interior wiring systems.
 4. Main distribution panel, panelboards.
 5. Non-current carrying parts of fixed equipment.
 6. Grounding terminal of all receptacles.
 7. Motors.
 8. Transformer case and neutral.
- B. Install ground rod vertically, with top flush with ground level unless physically protected. Connect to water service on street side of main shutoff valve, building structural steel, and service transformer ground rod.
- C. Provide ground strap between each wiring device and its associated outlet box.
1. Exception: Straps may be omitted if self-grounding devices are utilized.
- D. Provide separate ground conductor full length of all raceways. Ground conductor is not shown on the drawings, and is in addition to conductors shown.
- E. Provide a ground bar at telephone backboard. Provide (1) #2 AWG continuous, insulated ground conductor from ground bar to the main electrical service ground bar. Provide (1) #6 AWG insulated ground conductor from ground bar to each telecommunications rack in the telecommunication spaces.

3.2 TESTING

- A. Test ground electrode as required to assure resistance to ground less than 25 ohms. If resistance is higher than 25 ohms, add an additional interconnected ground rod. Install additional ground rods no closer than 10 feet from original rod.

END OF SECTION 260526

SECTION 260533 – RACEWAY SYSTEM

PART 1 - GENERAL

1.1 PROVISIONS

- A. All power wires and cables shall be enclosed in a raceway unless specifically noted otherwise.
- B. All system cables in in-assessable locations, e.g. in wall or above hard ceilings, shall be in conduit.
- C. All raceways shall be concealed unless noted otherwise.
- D. Separate raceway systems shall be provided for each of the various wiring systems (power, television, telephone, etc.). Raceways for telecommunication cabling shall comply with ANSI/TIA/EIA Standards 568 and 569.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26, 27 and 28.
- B. See Sections 013513, 260500, and 260519.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts. Submit parts replacement/ordering information as part of O & M Manuals.
- B. All submittals shall be made in accordance with requirements of Section 260500 and Division 01.

PART 2 - PRODUCTS

2.1 PROHIBITED MATERIALS

- A. "Pot-metal" or cast fittings, couplings, or connectors.
- B. Aluminum raceways.

2.2 MATERIALS

- A. Rigid Steel Conduit: Standard iron pipe size with screwed joints for electrical raceway use, in conformance with ANSI C80.1 "Rigid and Steel Conduit." Raceway shall be zinc coated by hot dip galvanizing or sherardizing. Manufacturer shall be Allied Tube and Conduit or Triangle PWC.
- B. Electrical Metallic Tubing: Zinc-coated steel in conformance with ANSI C80.3 "Electrical Metallic Tubing," manufactured by Allied Tube and Conduit, or Triangle PWC.
- C. Rigid Non-Metallic Conduit: Polyvinyl chloride, Schedule 40, heavy-wall, U.L. labeled, in conformance with U.L. Article 651 and NEMA TC-2 as manufactured by Carlon Electrical Products or P.W. Pipe.

- D. Rigid Non-Metallic Conduit, Type "EB": Polyvinyl chloride, designed for encased burial, in conformance with U.L. 651A, U.L. 657A, and NEMA TC-6, as manufactured by Carlon Electrical Products or P.W. Pipe.
- E. Flexible Conduit: Galvanized steel in conformance with UL-1 "Flexible Metal Conduit", manufactured by International, American Brass, or All-Flex.
- F. Flexible Conduit, Liquidtight: Galvanized steel in conformance with UL-360 "Liquid-Tight Flexible Steel Conduit", manufactured by American Brass Co. "Sealtite" or "Flex-Seal" with copper bonding tape and with weatherproof exterior jacket.
- G. Surface Metal Raceway: Galvanized steel with snap-on covers, finished with manufacturer's standard prime coating suitable for painting, in conformance with UL-5 "Surface Metal Raceways and Fittings", manufactured by Wiremold, or Walkerdect, of size required for wiring, furnished with all associated hardware.
- H. Fittings, Couplings and Connectors: Utilize fittings listed and approved for specific conduit or raceway system used. All fittings, couplings, and connectors shall be steel or malleable iron and shall have insulated bushings molded or locked into the metallic body of the fitting for protection of conductors. Fittings for galvanized rigid steel raceways shall be the threaded type. Fittings for EMT shall be or compression type. Fittings for flexible conduit shall be of the wedge and screw or the squeeze and clamp type. Fittings for liquid tight flexible conduit shall have a threaded grounding cone, and a compression ring with gland for tightening. Fittings shall be manufactured by Appleton, Thomas & Betts, Steel City, OZ/Gedney or same manufacturer as conduit.

2.3 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers shall be as listed above.
- B. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 PROHIBITED LOCATIONS AND INSTALLATION METHODS

- A. Electrical metallic tubing shall not be installed underground or in concrete.
- B. No raceway shall be secured to the ceiling system, ceiling hangers, HVAC ductwork, or mechanical piping.
- C. Rigid non-metallic conduit shall not be used inside a building unless encased in concrete.

3.2 REQUIRED LOCATIONS

- A. Rigid steel conduit shall be used for all exposed exterior raceways, for transition of non-metallic raceways before rising above floor slabs or grade and in locations specifically noted or required by code.
- B. Rigid non-metallic conduit shall be used for all conduits installed underground (with rigid steel elbows), in concrete slabs and in locations where specifically noted.

- C. Flexible conduit shall be used only for connections to recessed lighting fixtures, motors and equipment, and shall be limited to dry locations. Maximum length shall be six (6) feet.
- D. Liquidtight flexible conduit shall be used in place of flexible conduit in damp or wet locations, including all connections to pumps.
- E. Surface metal raceways shall be used only in finished areas where surface raceways are required by building conditions or as specifically noted.
- F. Electrical metallic tubing shall be used in all locations not noted above.

3.3 INSTALLATION

- A. Underground raceways (other than single conduits) shall be arranged as shown in NEC Figure B.310.2. Maximum depth to the top of all buried raceways shall be 30 inches.
- B. Maximum size raceway to be installed in concrete floor slabs shall not be larger in outside diameter than $\frac{1}{3}$ the overall thickness of the slab. Raceways shall be installed in middle third of the slab thickness and leave at least 1 inch concrete cover. Raceways shall be secured to reinforcing to prevent sagging or shifting during concrete placement. Raceways shall be spaced no closer than three diameters laterally to prevent voids in the concrete. Curved portions of bends shall not be visible above the finished slab.
- C. Non-metallic raceways run in concrete slabs shall make a transition to rigid steel conduit before rising above the slab.
- D. Stub-ups in floor slabs shall be made with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. For connections to equipment, extend raceway from fitting with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor.
- E. Maintain 6 inch separation from steam and hot water lines.
- F. All raceways shall be installed parallel with or at right angles to the building lines, and not installed diagonally.
- G. The locations of all raceways shall be coordinated with all other trades. If a conflict occurs due to lack of this coordination, then changes in the location of the raceways shall be made without extra charge.
- H. For conduits one inch and larger, hickey bends are not acceptable. Either manufactured elbows or bends fabricated in a bending machine must be used.
- I. Where a conduit enters a box or other fitting through a knockout, an approved double locknut and insulating bushing must be provided. All conduits shall be equipped with insulating bushings at all outlets, pull boxes, panels, etc.
- J. Flexible conduit connections to motors shall include (1) 90 degree bend.
- K. All conduit shall be cleaned by pulling a swab through the conduit before pulling in wires.

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- L. Branch raceway runs are shown schematically. Except where exact routing is indicated, branch circuits raceways may be grouped, and the actual routing of branch circuit raceways may be altered, providing actual locations are properly entered on the "As-Built" drawings.
- M. Conduit connections between outlet boxes less than 24 inches apart on opposite sides of a wall shall be made with a loop of flexible conduit (no nipples).
- N. Provide expansion fittings for all rigidly fastened conduits spanning expansion joints, and for all runs 1-1/2 inch or larger exceeding 150 feet in length. Fittings shall be hot-dipped galvanized malleable iron with a packing ring to exclude water, a pressure ring, and a separate external bonding jumper.
- O. Seal around all conduits at ceiling, floor, and wall penetrations with an approved fire stop material to provide airtight fireproof seal.
- P. Provide roof jack at all roof penetrations. Coordinate roof jack type and installation with General Contractor. Equipment must be compatible with required roof guarantee.
- Q. Install raceway sealing fittings per the manufacturer's recommendations. Sealing fittings shall be located in approved, accessible locations and filled with U.L. listed sealing compound. For concealed raceways, install fittings in a flush steel box with a blank cover. Sealing fittings shall be installed where raceways enter/leave a hazardous area, a refrigerated area and as otherwise required by the code.
- R. Where conduit runs are 100 feet or longer contain the equivalent of four (4) 90° bends, pull/junction boxes shall be provided. Pull box locations shall be indicated on the record drawings.
- S. Minimum size conduit shall be 3/4 inch, except where a single circuit of two #12 or two #14 AWG wires are installed, which requires 1/2 inch conduit minimum. Minimum size conduit to be 3/4 inch below grade. Conduit sizes shown on the drawings shall supersede these requirements.
- T. All unused raceways shall be provided with a nylon pull string. Raceways larger than 1-1/2 inch shall be provided with a 1/4 inch poly pull line.

END OF SECTION 260533

SECTION 260535 - PULL AND JUNCTION BOXES

PART 1 - GENERAL

1.1 PROVISIONS

- A. Furnish and install pull and junction boxes in all locations shown or required for proper installation of the raceway and wiring systems.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 1 apply to work specified in each section of this Division 26, 27, 28.
- B. See Sections 013513, 260500, 260533 and 260553.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide galvanized sheet steel junction and pull boxes, with screw-on covers, of the type, shape, and size to suit each respective location and installation.
 - 1. Type for various locations:
 - a. 100 cubic inches or smaller: Standard outlet box with stamped knockouts.
 - b. 150 cubic inches or larger: Code gauge steel with slides formed and welded, with screw covers unless shown to have hinged doors. Hinged doors shall have locking device same as furnished for panelboards. Knockouts shall be factory stamped, or formed in the field with a cutting tool to provide a clean, symmetrically cut hole.
 - c. Exterior or wet areas: Weatherproofed galvanized steel construction with proper gaskets and corrosion resistant fasteners.

2.2 APPROVED MANUFACTURERS

- A. Pull and junction boxes shall be as manufactured by the following:
 - 1. Appleton Electric Co.
 - 2. Arrow-Hart, Inc.
 - 3. Keystone Columbia, Inc.
 - 4. O.Z./Gedney Co.
 - 5. Panelboard/Switch board manufacturer as described in Section 262416.
- B. Substitutions may be considered only when submitted in conformance with Section 260510.

PART 3 - EXECUTION

3.1 PROHIBITED INSTALLATION METHODS

- A. No box shall be secured to the ceiling system, HVAC ductwork, or mechanical piping.

3.2 INSTALLATION

- A. Install electric boxes as indicated, and in compliance with N.E.C. requirements, in accordance with manufacturer's recommendations and with recognized industry practices to ensure that the boxes serve the intended purpose.
- B. Provide pull and junction boxes wherever necessary for proper installation of the various electrical systems.
- C. Provide knockout closures to cap all unused holes where blanks have been removed.
- D. Coordinate and locate boxes to ensure accessibility of electrical wiring.
- E. Secure boxes rigidly to the building element on which they are mounted, or solidly embed boxes in concrete or masonry.
- F. Identify all boxes with label showing the individual feeder or electrical system. See Section 260553.

END OF SECTION 260535

SECTION 260538 - OUTLET BOXES

PART 1 - GENERAL

1.1 PROVISIONS

- A. Each switch, wall receptacle, light fixture, and other miscellaneous device shall be provided with an outlet box.
- B. All outlet boxes in the office area and the scale house shall be of the flush type unless specifically noted otherwise.
- C. All outlet boxes in the garage area shall be of the surface type unless specifically noted otherwise.
- D. Box dimensions shall be selected to meet wiring space requirements. Depth may be limited by building conditions.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26, 27, 28.
- B. See Sections 013513, 260500, 260533, and 262726.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts on standard equipment, and shop drawings for all custom equipment. Submit parts replacement/ordering information as part of O & M Manuals.
- B. All submittals shall be made in accordance with requirements of Section 260510 and Division 01.

PART 2 - PRODUCTS

2.1 PROHIBITED MATERIALS

- A. Sectional outlet boxes shall not be utilized.

2.2 MATERIALS

- A. Flush outlet boxes shall be galvanized pressed steel, of the knockout type, not less than 4" square, minimum 14 U.S. gauge.
- B. Provide extension rings for all flush boxes. Boxes which occur in concrete block walls shall be equipped with 1-1/2" square cornered tile extensions.
- C. Surface mounted outlet boxes shall be utilized only in mechanical spaces and other unfinished areas in conjunction with exposed conduits, and shall be pressed steel.
- D. Boxes for exterior below grade installation shall be watertight, rated for exterior use, with gasketed covers and watertight connections. Boxes shall be cast steel, fully coated with corrosive protective compound. Boxes in paved areas shall be traffic rated.

2.3 ACCEPTABLE MANUFACTURERS

- A. Pressed steel boxes shall be manufactured by Bowers, Raco, or Steel City.
- B. Cast exterior boxes shall be manufactured by OZ.
- C. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All outlet boxes in finished areas shall be flush unless specifically noted otherwise.
- B. This Contractor shall carefully lay out all outlets and check with the plumbing, heating, ventilating, and other contractors so that the outlets are not blocked, hidden, or rendered inaccessible due to equipment or piping of these trades passing over, under, across, or in close proximity to same, or to cause the devices or fixtures in or on these outlets to be inaccessible for use or maintenance.
- C. Any minor changes in the location of outlets from those shown on the plans shall be made without extra charge if so directed by the Architect before installation.
- D. Where two or more of the same type devices occur adjacent to each other, they shall be in a gang type box with a gang type cover. Where different type devices occur adjacent to each other, space outlet boxes so that finish plates will be spaced one inch apart (verify with Architect).
- E. Contractor shall consult the Architectural drawings for exact height of all outlets not specified herein or shown on the drawings.
- F. Flush ceiling and wall outlet boxes shall have a 3/8" fixture stud where fixture depends on such for support.
- G. Each ceiling outlet occurring in a suspended ceiling shall be supported from a bar hanger rigidly attached to ceiling support channels.
- H. Outlet boxes shall be supported independent from the raceway system.
- I. All switch outlets shall be located where shown, on strike side of door, and shall be 6" from the door casing, unless it is necessary to center switch between door and other construction for appearance.
- J. Where two or more outlets occur on the same wall, unless individually noted otherwise, they shall be mounted at exactly the same height.
- K. Where outlets are shown side by side but at different heights, they shall be centered one above the other unless otherwise indicated.
- L. Outlets which are shown immediately opposite one another on two sides of a wall shall have boxes sized to prevent contact between the two. Nipples between boxes are prohibited.
- M. All unused openings in outlet boxes must be left sealed or closed with plugs.

- N. Grout around all outlet boxes to seal space between box and wall or ceiling materials.

3.2 MOUNTING HEIGHTS

- A. Outlet boxes shall be mounted at heights as shown on the drawings. Dimensions are measured to the top of the box unless a "B" follows the dimension. In this case, the dimension is to the bottom of the box.

END OF SECTION 260538

SECTION 260551 - DEVICE PLATES

PART 1 - GENERAL

1.1 PROVISIONS

- A. Provide each wiring device and each outlet with a plate.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26.
- B. See Sections 260500, 260538, and 26272.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts on standard equipment, and shop drawings for all custom equipment. Submit parts replacement/ordering information as part of O & M Manuals.
- B. All submittals shall be made in accordance with requirements of Section 260500 and Division 01.

PART 2 - PRODUCTS

2.1 PROHIBITED MATERIALS

- A. Sectional plates shall not be utilized.

2.2 MATERIALS

- A. All devices in finished areas shall be equipped with satin finished stainless steel plates, of type to match device.
- B. All junction boxes shall be provided with plates.
- C. All telephone outlets shall be Hubbell NS723SS.
- D. Plates on exposed pressed steel boxes shall be pressed steel of the same manufacture as the box, unless noted otherwise.

2.3 ACCEPTABLE MANUFACTURERS

- A. Plates shall be Hubbell stainless.
- B. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install plate on each device outlet, communications outlets, and junction box.

B. Device plates shall be fitted tight to wall.

END OF SECTION 260551

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 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches.
 - 3. Indoor occupancy sensors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 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.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide Cooper Greengate or a comparable product by one of the following:
 - 1. Cutler-Hammer
 - 2. General Electric
 - 3. Hubbell
 - 4. Intermatic, Inc.
 - 5. Leviton Mfg. Company Inc.
 - 6. Lightolier Controls; a Genlyte Company.
 - 7. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 8. Square D; Schneider Electric.
 - 9. Touch-Plate, Inc.
 - 10. Watt Stopper (The).
- D. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
 - 1. Contact Configuration: SPST.
 - 2. Programs: 10 channels; each channel shall be individually programmable with 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week, and an annual holiday schedule that overrides the daily operation on holidays.
 - 3. Astronomic Time: All channels.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide Intermatic K4123C or a comparable product by one of the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.
 - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 3. Intermatic, Inc.
 - 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 5. Novitas, Inc.
 - 6. Paragon Electric Co.; Invensys Climate Controls.
 - 7. Square D; Schneider Electric.
 - 8. TORK.
 - 9. Touch-Plate, Inc.
 - 10. Watt Stopper (The).

- D. Description: Solid state, with SPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.
 - 1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
 - 2. Time Delay: 30-second minimum, to prevent false operation.
 - 3. Mounting: Stem mounting.

2.3 INDOOR OCCUPANCY SENSORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell LHMTS1I or LHMTS2I or a comparable product by one of the following:
 - 1. Hubbell Lighting.
 - 2. Leviton Mfg. Company Inc.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Sensor Switch, Inc.
 - 5. Watt Stopper (The).
- D. General Description: Wall switch mounting, solid-state units.
 - 1. Operation: Unless otherwise indicated, turn lights on manually and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
 - 2. Rating: 277 Volt AC, 1800 Watt fluorescent.
- E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Automatic adaption to prevent false event switching.
 - 2. Detection Coverage: Detect occupancy anywhere within an area of 1000 sq. ft.

2.4 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."

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

- A. Identify components and power and control wiring.
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to 2 visits to Project during other-than-normal occupancy hours for this purpose.

3.5 TRAINING

- A. Provide two hours training for owner’s representatives.

3.6 PROGRAM

- A. Initial program is to be as follows:

	<u>On</u>	<u>Off</u>
1. Panel P1		
a. Circuit 10	0600	1800
2. Panel H1		
a. Circuit 1	0600	1700
b. Circuit 3	0600	1700
c. Circuit 5	0600	1700
d. Circuit 7	0700	1700
e. Circuit 9	Sunset + 30 minutes	Sunrise – 30 minutes
f. Circuit 11	Sunset	Sunrise
g. Circuit 13	Sunset + 30 minutes	Sunrise – 30 minutes

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 260923

SECTION 262213 - DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 PROVISIONS

- A. Furnish and install dry type transformers in the locations shown on the drawings.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26.
- B. Section 260500 and 260526.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts. Submit parts replacement/ordering information as part of O & M Manuals.
- B. Include data required in "Test Reports" below, plus dimensions, weight, and optional features.
- C. All submittals shall be made in accordance with requirements of Section 260500 and Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Size and rating shall be as shown on the drawings.
- B. Transformers shall have Class H insulation with a maximum temperature rating of 150 degree C over a 40 degree C ambient.
- C. Transformer shall be equipped with integral insulating pads.
- D. Transformers shall be manufactured to meet NEMA and ASA standards.
- E. Maximum sound level shall be 50 db.
- F. Termination lugs shall be of the bolted type.
- G. Transformers will operate at 98.2 efficiency at 35% of nameplate load as per the requirements of NEMA TP-1-2002 Table 4-2.

2.2 ACCEPTABLE MANUFACTURERS

- A. Transformers shall be Square D Type EE.
- B. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount each unit in the location shown, in accordance with manufacturer's recommendations.
- B. Transformers shall not be in physical contact with walls, ductwork, piping, or other building elements, except for base and flexible conduit connection.
- C. Mount each unit on pad type vibration isolators. Select isolators to match unit weight.
- D. All conduit connections shall be of the flexible type. Minimum flexible conduit length is 24".

3.2 TEST REPORTS

- A. Provide standard test report for each transformer with submittal data. Report shall include:
 - 1. No load losses
 - 2. Voltage ratio
 - 3. Sound level
 - 4. Temperature rise
 - 5. Full load losses
 - 6. Regulation
 - 7. Impedance

END OF SECTION 262213

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 PROVISIONS

- A. Furnish and install all lighting and power panels shown on the drawings. Panels shall be mounted in steel cabinets arranged for flush or surface mounting as shown on the plans.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26, 27, 28.
- B. See Sections 260510 and 260553.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts on standard equipment, and shop drawings for all custom equipment. Submit parts replacement/ordering information as part of O & M Manuals.
- B. Include drawing showing height, width, and depth of each panel.
- C. Include schedule showing circuit breaker size and number of poles, keyed to circuit number. Schedule shall be arranged the same as the panel schedules included in the specifications.
- D. All submittals shall be made in accordance with requirements of Section 260510 and Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cabinet and trim shall be of code gauge steel (minimum) with 4" (minimum) wiring gutter all around. All panelboards shall be equipped with a hinged, locking door. Two keys shall be furnished with each cabinet, and all locks on all cabinets shall be keyed alike.
- B. Where panels occur adjacent to one another, cabinets and doors for each panel shall be of the same height.
- C. All surface mounted panels, unless noted otherwise, shall extend from the floor to the top of the panel, with dividers, blank panels, and miscellaneous hardware as required. Entire cabinet (less front) shall be furnished as one piece, or if not of one piece construction, shall have factory fabricated metal skirts which are designed to provide positive alignment of top and bottom sections. Panelboards which have sections which are not perfectly aligned will not be accepted.
- D. All panelboards shall be painted with gray lacquer over rust preventative primer. Sides and top of surface mounted panels shall be painted to match fronts.
- E. Panels shall be of the circuit breaker type, and shall have capacity and arrangement as shown on the panel schedule.

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- F. Branch circuit breakers shall be bolt-on type and shall be of the ambient compensated, thermal magnetic type, which will provide inverse time delay overload, and instantaneous short circuit protection. All branch circuit breakers shall have a minimum interrupting rating of 10,000 amperes RMS symmetrical. Branch circuit breakers shall have one, two or three poles as designated on the panel schedule. No circuit breakers utilizing handle ties for two or three pole operation will be acceptable.
 - 1. Voltage and current ratings shall be as indicated on the drawings.
- G. Provide a typewritten directory for each panel, placed inside the panel door. The directory shall list all rooms served by each breaker, using the "Owner's" room numbers. Directories shall be installed in a metal directory frame and glass. Spares and spaces shall be written in pencil.
- H. Where panels contain contactors, they shall be mounted behind a hinged, locking door. Contactor section shall be below the circuit breaker section unless otherwise noted. Provide all required barriers.
- I. Each panel shall be equipped with a ground lug for feeder ground.
- J. Each panel and cabinet and the units comprising same shall bear the manufacturer's nameplate and the U.L. label.

2.2 ACCEPTABLE MANUFACTURERS

- A. Panelboards shall be Square D Type #NQ or NF.
- B. Other Acceptable Manufacturers: G.E., Cutler-Hammer, or Siemens equipment which is the approved equal of the above is considered acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount panels in locations shown, making sure that code-required clearances exist.
- B. All panels shall be mounted with top at the same height; approximately 6'-6".
- C. Panels in finished areas, e.g. Scale House, shall be flush mounted. Where cabinets cannot be set fully flush due to shallowness of all of partition, trim protruding sides with approved metal or hardwood moulding, fastened to cabinet so as to conceal intersection of wall and cabinet. Panels in unfinished areas, e.g. Shop and Shop Mezzanine, shall be surface mounted.
- D. If paint is damaged during shipping or installation, damaged portion shall be sanded smooth and entire panel repainted.
- E. Provide (5) 3/4" conduits stubbed into accessible ceiling spaces above and below each flush mounted panel.
- F. Install bakelite nameplates, fabricated from black bakelite, with 1/4" or 3/8" engraved white letters, on outside of panelboard above door.

END OF SECTION 262416

SECTION 262417 - DISTRIBUTION PANELS

PART 1 - GENERAL

1.1 PROVISIONS

- A. Furnish and install Distribution Panels in locations shown on the drawings.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26.
- B. See Sections 260500, 260553, and 262813.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cabinets shall be manufactured from code gauge steel, with wiring gutters all around. Cabinet sides, top, bottom, and fronts shall be painted with gray lacquer over a rust preventative primer.
- B. Panels shall include all circuit protective devices shown on the drawings. All devices shall be connected with bar connection straps having line and load connections accessible from the front.
- C. Busing shall be rated at 120/208 and 480/277 volts, three phase, four wire, of capacity as shown on the drawings.
- D. All bolted connections shall be made with Bellville washers.
- E. See Section 262813 for fuse requirements.
- F. Distribution Panels shall have nameplates (see Section 260553) with 1/4" high letters for each protective device. Nameplate shall indicate circuit service.

2.2 ACCEPTABLE MANUFACTURERS

- A. Distribution panels and protective devices shall be Square D Type I-Line.
- B. Other acceptable manufacturers: GE, Eaton, or Siemens equipment which is the approved equal of the above is considered acceptable.
- C. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount panels in locations shown, making sure that code required clearances exist.

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- B. If paint is damaged during shipping or installation, damaged portion shall be sanded smooth and entire panel repainted.

END OF SECTION 262417

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 PROVISIONS

- A. Provide wiring devices at all device outlet locations shown on the drawings.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26.
- B. See Sections 260500 and 260538.

1.3 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. Complete manufacturer's data, including catalog cuts. Submit parts replacement/ordering information as part of O & M Manuals.
- D. All submittals shall be made in accordance with requirements of Section 260500 and Division 01.

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. Comply with NFPA 70.

1.5 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
- B. Cord and Plug sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Manufacturers and catalog numbers are scheduled to establish the standard of quality required. Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. GE Company: GE Wiring Devices.

- b. Hubbell, Inc. Wiring Devices Division.
- c. Leviton Manufacturing Co., Inc.

2.2 RECEPTACLES

WALL RECEPTACLES	
Duplex Receptacles	Hubbell # HBL5362I
Tamper Resistant GFI Receptacle	Hubbell # GFR5362SGI
Weatherproof Receptacles	Hubbell # GFR5362SGI w/#WP26M plate

2.3 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable clamping jaws. Match cord and receptacle type for connection.

2.4 POWER CORD DROP REELS

- A. Drop cords are to be 45 feet long have one GFI protected duplex 20 A receptacle. Basis of design is Hubbell #HBL45123GF20. Adjust cord stop so receptacle retracts to 7 feet A.F.F.

2.5 SWITCHES

WALL SWITCHES	
Single Pole Switches	Hubbell #HBL1221I
Double Pole	Hubbell #HBL1222I
Three-Way Switches	Hubbell # HBL1223I
Four-Way Switches	Hubbell # HBL1224I
Weatherproof Switch	Hubbell # HBL1221I w/ HBL1795 plate
Occupancy Sensor Switch 1 Circuit	Hubbell # LHMTS1I
Occupancy Sensor Switch 2 Circuit	Hubbell # LHMTS2I
Occupancy Sensor Switch 2 Circuit for Light and Exhaust Fan	Cooper Greengate #ONW-D-1001-DMV-V

2.6 FINISHES

- A. Color: Ivory, unless otherwise indicated.
- B. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide wall plates on all devices.

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- B. Install devices and assemblies plumb and secure.
- C. Install wall plates when painting is complete.
- D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- E. Protect devices and assemblies during painting.
- F. Offset outlet boxes installed on opposite sides of a partition by a minimum of 6 inches to reduce sound transmission.
- G. Occupancy sensor switches shall have automatic adjusting time delay; e.g. Hubbell IntellADAPT.
 - 1. Exception: two circuit occupancy sensor switches in Kitchen and Scale House Toilet Room 202 shall have the exhaust fan circuit delay set to 30 minutes. Light delay shall be automatic.

3.2 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity.
- B. Test GFCI operation according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.3 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 PROVISIONS

- A. Furnish and install fuses in all fusible equipment, and provide spare fuses as described herein.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26.
- B. See Sections 260500, 262473, 262816, and 265100.
- C. The supplier shall submit a list of fuse manufacturers and types to be used on this project for review. Time current curves for all fuses shall be submitted to the Engineer for his use. Curves shall be drawn for minimum melting time and for total clearing time on standard log-log transparency paper or mylar.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts, time-current curves, and coordination data as required below. Submit parts replacement/ordering information as part of O & M Manuals.
- B. All submittals shall be made in accordance with requirements of Section 260510 and Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fuses shall be high interrupting, current-limiting, U.L. approved, and shall be Bussman types listed below:

MAIN SWITCHES AND FEEDERS	250 V	600V
GENERAL PURPOSE	LPJ	LPJ
MOTORS	FRN-R	FRS-R

2.2 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers shall be as listed above.
- B. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish and install fuses in all fusible equipment. Type shall be selected from the above schedule. Ampacity shall be as shown on the drawings, or selected to match equipment rating.

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- B. Provide fuse clips and adaptors as required to match fuse type to fuseholder.
- C. Install fuses in fuseholder with fuse rating visible.
- D. Provide (3) spare fuses of each different type and size used on the project.

END OF SECTION 262813

SECTION 262816 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 PROVISIONS

- A. Provide motor and/or circuit disconnect switches in all locations shown or specified and in all locations required by code.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26.
- B. See Sections 260500, 260553, 262813, and 262924.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts. Submit parts replacement/ordering information as part of O & M Manuals.
- B. All submittals shall be made in accordance with requirements of Section 260500 and Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Each motor and equipment item shall be equipped with a two or three pole, fused, heavy-duty disconnect switch, sized to match the motor or equipment.
 - 1. Disconnect switches for single phase equipment connected to 20-ampere circuits shall be enclosed, toggle-type switches.
- B. Switches shall be externally operable, quick-make, quick-break, with neutral connecting block as required, and lockable operating handle. Mount in code gauge steel cabinet.
- C. See Section 262813 for fuse requirements.
- D. Provide Class R rejection kits on fuseholders.

2.2 ACCEPTABLE MANUFACTURERS

- A. Disconnect switches shall be manufactured by the panelboard manufacturer. See Section 262416.
- B. Substitutions may be considered only when submitted in conformance with Section 260500.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switch at the controller location and wire to disconnect both motor (or equipment) and controller. If the motor (or equipment) is not in sight from the controller location, provide a second disconnect switch at the motor (or equipment), whether shown on the drawings or not.

END OF SECTION 262816

SECTION 262817 - CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 PROVISIONS

- A. Provide molded-case, insulated case or power circuit breaker mounted in grouped equipment, i.e., switchboards, panelboards, etc.
- B. Related Specifications:
 - 1. See Sections 260534, and 262416.
- C. The Contractor shall submit the following shop drawings and data for review by the Engineer:
 - 1. Ratings: Voltage, frame size, trip rating, trip settings, interrupting capacity at rated voltage.
 - 2. Dimensions, and mounting details.
 - 3. Certification that the breakers conform to the standards required and that they are all listed for the applications on this job.
 - 4. Time-current curves on standard log-log transparencies.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Where interrupting current ratings are shown that do not comply with the standard ratings of the manufacturer, the next highest rating shall be provided by the Contractor.
- B. Molded case breakers shall comply with NEMA Standard AB-1-1986. They shall be thermal magnetic trip free, non-interchangeable trip, non-adjustable trip unless otherwise noted.
- C. Molded case breakers in distribution panels MDP and PD, and in panel H1 shall be fully rated to the values shown on the one-line diagram. Circuit breakers in 208/120 Volt panelboards rated 225 Amperes or less may be series rated, but shall have minimum interrupting capacity ratings of 10,000 A RMS minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Molded case breakers shall be firmly attached to bus and cable. Connections shall be rechecked after the first load cycle has been applied to the breaker.
- B. Individual units in enclosure shall be mounted at 4' - 6" above the floor on walls and 3' - 6" above floor, when strut supported at motors, etc.
- C. Panelboards with series rated circuit breakers shall be so labeled next to the panel identification on the front of the panel. Label is to match panel identification, fabricated from black bakelite, with 1/4" or 3/8" engraved white letters.

END OF SECTION 262817

SECTION 262924 - MOTOR CONNECTIONS

PART 1 - GENERAL

1.1 PROVISIONS

- A. Furnish and install all power wiring for all permanently installed motors, starters, equipment and control systems. All circuit protection, disconnect switches, and motor starters shall be furnished by Division 26 - Electrical, except for specifically noted starters, starters integral to Motor Control Centers provided by Division 26 and starters integral to equipment specified in other Sections. Review all contract documents for requirements.
- B. Motor starters and disconnect switches locations are indicated on the drawings. It shall be understood that the symbol representing "motor connection" shall include disconnect switches at all motors and starters, and starters where required.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26, 27, 28.
- B. See Sections 260500, 262816, 283111.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide all required relays, wiring, and miscellaneous equipment for Fire Alarm Fan Shutdown. Interconnecting controls shall be rated to match starter control voltage.
- B. Branch circuit protection and disconnect switches shall be provided under Division 26. See Sections 262416, and 262816

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Make a single (unless otherwise noted) line voltage connection to each motor and equipment item, and "line and load" line voltage connections to motor starters.
- B. Check the rotational direction of all motors after final service connections have been made, and make all phase corrections required.
- C. Check all motors for proper lubrication and overload protection before placing in operation.

END OF SECTION 262924

SECTION 264313 - SURGE PROTECTIVE DEVICE (SPD)

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 RELATED SECTIONS

- A. 26 24 16 Lighting and Appliance Panelboards
- B. 26 24 17 Distribution Panels

1.3 SUMMARY

- A. This Section describes the materials and installation requirements for Surge Protective Devices (SPD). SPD's are used for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.
- B. This specification also describes the mechanical and the electrical requirements for the SPD. The SPD shall be suitable for application in both category B and C environments as described in ANSI/IEEE C62.41- 2002.
- C. The Manufacturer/Vendor shall furnish all of the necessary SPD products and related hardware (i.e. flush mounting kits, mounting brackets, etc.) as required for the installation of the SPD system suitable for the application.

1.4 REFERENCE STANDARDS

- A. ANSI C84.1 (American National Standards Institute) - American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hertz).
- B. IEEE C62.41.1 (Institute of Electrical and Electronics Engineers) - Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits.
- C. IEEE C62.41.2 (Institute of Electrical and Electronics Engineers) - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
- D. IEEE C62.45 (Institute of Electrical and Electronics Engineers) - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- E. IEEE 142 (Institute of Electrical and Electronics Engineers) - IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (Green Book).
- F. IEEE 1100 (Institute of Electrical and Electronics Engineers) - IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (Emerald Book).
- G. NEMA LS-1 (National Electrical Manufacturer's Association) - Low Voltage Surge Protective Devices.
- H. NFPA 70 (National Fire Protection Association) - National Electrical Code.

- I. UL 1283 (Underwriters Laboratories) - Standard for Safety for Electromagnetic Interference Filters.
- J. UL 1449/ANSI (Underwriters Laboratories) Third Edition - Standard for Safety for Surge Protective Devices.

1.5 SUBMITTALS

- A. Submittals shall include written specification response referencing each specification section and sub-section indicating compliance or non-compliance. If manufacturer cannot fully comply with specification section, this must be stated in the response along with a full description of the variance. Submittal responses shall be signed by manufacturer's VP of Engineering or Product Line Manager.
- B. Submit 3 copies of the following indexed by response and test results a minimum of 2 weeks in advance of the date the submittal evaluation needs to be completed for the project.
 - 1. Specification compliance response sheet referencing each specification section.
 - 2. Proof of UL1449 Third Edition compliance from Nationally Recognized Test Lab (NRTL) accepted by local authority having jurisdiction. UL1449 Third Edition Nominal Discharge Current Rating and Voltage Protection Ratings shall be provided.
 - 3. UL1283 filter compliance documentation.
 - 4. Published specifications, cut sheets & product data with appropriate NEMA LS1 and IEEE C62.41 performance ratings for intended installation locations.
 - 5. Electrical and mechanical shop drawings.
 - 6. Installation requirements/instructions.
 - 7. Operations & maintenance manuals.
 - 8. Performance / warranty information.
- C. The Engineer reserves the right to accept or reject any or all submittals, to request additional information as deemed necessary or to request submittals for a different unit deemed more appropriate for this installation.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Manuals
- B. Warranty Documentation

1.7 DELIVERY, STORAGE AND HANDLING

- A. Inspect for damage and replace any damaged device.
- B. Store in a clean, dry space suitable for equipment and protect against damage.
- C. Clean equipment and touch up minor scratches using suitable materials.

1.8 QUALIFICATIONS

- A. Manufacturer's SPD's shall have UL1449 Third Edition compliance & listing from Nationally Recognized Test Lab (NRTL) accepted by local authority having jurisdiction. Type 1 compliance required for SPD intended for installation before (or after) Main Service Disconnect or Type 2 compliance for installation after Main Service Disconnect. UL1449 Third Edition Nominal Discharge Current Rating and Voltage Protection Rating.

- B. Manufacturer shall have local representation and distribution within 300 miles of the project location to provide technical, warranty claim, and installation support for the project.
- C. Manufacturer/vendor must be capable of supplying SPD for project within 30 days of receipt of order for models submitted in response to this specification.
- D. Manufacturers shall be certified to latest ISO 9001 standard and shall be registered for the design and manufacturing of SPD devices.
- E. Manufacturer shall provide access to a readily available factory engineer for answering questions about this product.
- F. Only firms regularly engaged in the manufacture of SPD products for category C locations (ANSI/IEEE C62.41.1-2002), and whose products have been providing satisfactory service for not less than five years, shall be considered. Upon request, provide a customer reference list, with a minimum of five contact names and current phone numbers.
- G. Manufacturer qualifications shall be provided as part of the submittal.
- H. The successful manufacturer/vendor shall assign a technical contact person for SPD application, installation and warranty questions. This contact shall be available to provide a response to a technical question within a maximum of two business days.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS

- A. The following manufacturer have been pre-approved:
 - 1. Manufacturer
 - a. Main Service High Exposure Loads: Raycap 277-3Y-M1-3-06-C-H.
 - 2. Manufacturer
 - a. Branch Panels and Sub-Panels: Transtector 1101-464 (APEX IV 120WMR).

2.2 GENERAL DESIGN & PERFORMANCE REQUIREMENTS

- A. SPD Design:
 - 1. SPD shall be compatible with the electrical system voltage, current, system configuration and intended applications and shall be NRTL listed for such application.
 - 2. Parallel design only with individual protection components:
 - a. Line to Ground, Line to Neutral and Neutral to Ground for Wye and Single Phase distribution systems.
 - 3. Metal-Oxide Varistor (MOV) or Silicon Avalanche Suppressor Diode components shall be utilized as primary energy mitigation. Selenium cell, air gaps, gas tubes are not allowed.
 - 4. Maximum continuous operating voltage (MCOV) of all components (based on ANSI C84.1 standard voltages), not less than 115% of system voltage.
 - 5. Visual indication of protection status on each phase, visible from the front of the equipment.
 - 6. As a minimum, Branch Panel, Sub-Panel and series installed (branch circuit) SPD shall include a passive circuit which allows the SPD to actively follow the voltage waveform and provide a clamping envelope to limit low level IEEE C62.41 Category A ring waves (of either polarity) at all locations on the sine wave. This circuit shall also perform in the Neutral to Ground Mode.
 - 7. Complete, comprehensive installation instructions shall be provided for the SPD.

8. Enclosure:
 - a. NEMA rated metal enclosure appropriate for environmental conditions and exposure at point of installation.
 - b. Designed to allow connection of the SPD without sharp bends in the conductors.
- B. Performance and Ratings:
1. Minimum durability and performance requirements are described below in accordance with test procedures outlined in ANSI/IEEE C62.45, NEMA LS1 & UL1449 Third Edition. Test documentation shall be provided as part of the submittal package. Information shall be provided in a format which is easily to analyze and review. The following test data shall be submitted as manufacturer published literature:
 - a. Provide Maximum Surge Current (Single Pulse Rated, 8/20 μ S, by mode, Amperes) as per NEMA LS1-1992 – 2.2.9 with submittals document for each SPD proposed. For all electrical equipment located at Service Entrance or Category C locations, Surge current rating per phase in applicable modes shall be a minimum of 200kA. For SPD's with component level fusing, manufacturer to provide peak surge current ratings necessary to meet durability requirements.
 - b. Maximum surge current rating per phase in applicable modes shall be a minimum of 10kA for branch panel models.
 - c. For each SPD proposed, provide published durability test data utilizing the ANSI/IEEE C62.41-1991, Category C3, 20kV/10kA, 1.2 x 50 S - 8x20 μ S combination waveform for SPD durability tests with the ANSI/IEEE C62.41-1991, Category C1, 6kV/3kA, 1.2 x 50 μ S - 8x20 μ S combination waveform used for pre and post test measurement of let through performance variation. Provide test data with submittals, including test setup information.
 - d. All SPD devices (including branch panel) shall withstand a minimum of 10,000 IEEE C3 20kV/10kA hits delivered at a rate not exceeding one pulse per minute without failure or degradation exceeding 5% using IEEE B3 6kV/3kA combination waveform for pre and post durability let through measurement evaluation. Lead length for testing and let through measurements shall be 6".
 - e. UL Third Edition Nominal Discharge Current Ratings shall be a minimum of 20kA per mode for SPD's to be installed at the Service Entrance (or where direct lightning strike potential exists on outdoor feeder or branch circuit conductors serving electrical equipment) and a minimum of 10kA per mode for all other locations.
 - f. Provide EMI/RFI Attenuation as per Mil Std-220.
 - g. Maximum VPR (L-G) for SPD on the Main Distribution Panel is 1000 Volts. Maximum VPR (L-G) for SPD on the branch panels is 600 Volts. Provide published performance test data for the test configurations and waveforms listed in Tables with submittals.

2.3 WARRANTY

- A. Minimum requirements:
1. Period: 10 years from the date of substantial completion of service and activation of the system to which the SPD is attached.
 2. Full replacement of a suppressor which is damaged or fails to meet manufacturers published specifications and specifications provided within, without pro-rating value.

3. No exclusions from failure or damage from any system anomaly (over-voltage, single phasing, lightning strike, etc. (IEEE 62.41.1). Exceptions: failure caused by wiring error, loose or missing Neutral to Ground Bond or Meggar Testing with SPD connected to power system.
4. Factory or third party testing shall not be required.
5. Warranty shall apply independent of facility ownership / purchaser.
6. Replacement unit to be at facility within 7 business days of receipt of written notification of failure at no cost to the customer (exception – custom configuration or special order units).
7. Replacements: same make, model and configuration as original unit unless otherwise requested or approved.
8. Manufacturer site visit for validation of warranty claim: manufacturer/vendor must visit site within 3 days of notification at no cost. This section does not modify 1.12 (A) (6).
9. No shipping, handling, examination or other fees are allowed.

PART 3 - EXECUTION

3.1 WARRANTY

A. Minimum requirements:

1. Period: 10 years from the date of substantial completion of service and activation of the system to which the SPD is attached.
2. Full replacement of a suppressor which is damaged or fails to meet manufacturers published specifications and specifications provided within, without pro-rating value.
3. No exclusions from failure or damage from any system anomaly (over-voltage, single phasing, lightning strike, etc. (IEEE 62.41.1). Exceptions: failure caused by wiring error, loose or missing Neutral to Ground Bond or Meggar Testing with SPD connected to power system.
4. Factory or third party testing shall not be required.
5. Warranty shall apply independent of facility ownership / purchaser.
6. Replacement unit to be at facility within 7 business days of receipt of written notification of failure at no cost to the customer (exception – custom configuration or special order units).
7. Replacements: same make, model and configuration as original unit unless otherwise requested or approved.
8. Manufacturer site visit for validation of warranty claim: manufacturer/vendor must visit site within 3 days of notification at no cost. This section does not modify 1.12 (A) (6).
9. No shipping, handling, examination or other fees are allowed.

3.2 SERVICE ENTRANCE

A. Service Entrance Installation Requirements

1. One primary suppressor at the utility service entrance to the facility or as indicated on the drawings.
2. Suppressors shall be connected to properly rated disconnect with overcurrent and short circuit protective device connected on the load side of the service entrance disconnecting means in accordance with NEC requirements.
3. Conductors between suppressor and point of attachment shall be kept as short and straight as possible and shall be grouped together (via tie wrap) where possible. Lead length of connecting conductor shall not exceed two (2) feet without written permission of the Engineer.

4. Suppressor's ground shall be bonded to enclosure frame and the service entrance ground bus, and conduit between the SPD and the switchboard must provide secure electrical/mechanical connections.

3.3 BRANCH PANELS

A. Branch Panel applications

1. Install one secondary suppressor at each Branch locations as indicated on the drawings.
2. Provide complete flush mount kits including structural mounting brackets, matching flush mount plates and hardware for flush mount installations.
3. Suppressor shall be connected to properly rated disconnect with overcurrent and short circuit protective device in accordance with NEC requirements.
4. The SPD shall not limit the use of feed through lugs, sub-feed lugs and sub-feed breaker options.
5. Conductors between suppressor and point of attachment shall be kept as short and straight as possible and shall be grouped together (via tie wrap) where possible. Mount the SPD directly adjacent to the circuit breaker closest to the neutral bus, so the maximum length of connecting wiring shall not exceed 18 inches for all leads without written permission of the Engineer.
6. Suppressor's ground shall be bonded to enclosure frame and the equipment ground bus, and the electrical fitting between the SPD and the switchboard must provide secure electrical/mechanical connections.
7. The electrical gear shall be capable of being re-energized upon removal of the SPD.

END OF SECTION 264313

SECTION 265100 - LIGHTING

PART 1 - GENERAL

1.1 PROVISIONS

- A. Provide lighting fixtures in all locations shown on the drawings.
- B. Bidders shall acquaint themselves with the conditions and requirements of the building construction, as this work is based on furnishing all materials required to entirely complete each fixtures ready for use.

1.2 RELATED REQUIREMENTS

- A. All provisions of the contract including Division 01 apply to work specified in each section of this Division 26.
- B. See Sections 26050 and 262813.

1.3 SUBMITTALS

- A. Complete manufacturer's data, including catalog cuts on standard equipment, and shop drawings for all custom equipment. Submit parts replacement/ordering information as part of O & M Manuals.
- B. If lamps are included with the fixture, provide lamp submittal data.
- C. All submittals shall be made in accordance with requirements of Section 260500 and Division 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. See schedule for listing of required lighting fixtures. Fixtures shall be complete with trim, mounting hardware, and lamps.
- B. All fixtures shall bear the U.L. label associated with the type, location, and usage of the individual fixture.
- C. Fixtures manufactured with pre-painted metal will not be accepted.
- D. Each ballasted fixture shall have a voltage rating shall be selected to match circuit voltage.
- E. Fluorescent ballasts shall be program start for T5 lamps, program or instant start for T8 lamps, and have the following performance requirements:
 - 1. Power factor shall be 95% or greater at full light output.
 - 2. Total harmonic distortion and third harmonic distortion shall be less than 10%
 - 3. Ballast factor shall be greater than 0.85
 - 4. Lamp current crest factor shall be less than 1.5
 - 5. Operate at not less than 20kHz frequency and have no audible noise, performing at sound rating "A"

6. Provide at a minimum, normal rated lamp life as state by the lamp manufacturer
 7. Have class P thermal protection and be U.L. listed
- F. All fixtures shall be complete with lamps of one of the following types:
1. Fluorescent (T8, 265 ma.): Osram/Sylvania Octron "800XPS" series, 3500K.
 2. Fluorescent (Compact): Osram/Sylvania DULUX D/E series, 3500K.
 3. Metal Halide: Sylvania "Super-Metalarc", phosphor coated.
 4. All other lamps shall be as required by equipment or as noted on the drawings.
- G. All plastic lenses shall be K-12 virgin acrylic unless noted otherwise. All flat plastic lenses shall be 0.125" minimum thickness.
- H. All door frames for fluorescent fixtures shall be equipped with spring-loaded latches.
- I. All louvered fixtures shall be shipped with dust covers and shall be removed after final building vacuuming has been completed.
- J. Fixtures mounted to T-bar ceilings shall utilize standard T-bar accessories as manufactured by the A&G Co. or equivalent.
- K. Spares: Provide spare equipment in the following quantities:
1. Fluorescent lamps: (1) cases of each different size and type.
 2. HID lamps: (1) cases of each different size and type.
 3. Lenses: 10% (or 25 lenses, whichever fewer) of each different type.
- L. Fluorescent luminaires noted or indicated as emergency units shall be complete with an automatic battery pack assembly to operate one lamp. Assembly shall be Bodine or approved alternate. Luminaire shall have valid UL label with battery-pack installed. Installation shall be done at the luminaire's manufacturer's factory. Battery pack assemblies shall provide a minimum of 1100 lumens of light output and 1-1/2 hours of operation. Unit may be field installed if installation does not void UL label of battery pack or luminaires.

2.2 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers shall be as listed above, and in the fixture schedule.
- B. Substitutions may be considered only when submitted in conformance with Section 260510.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount fixtures securely and adequately to meet the requirements of NFPA 70, Para. 410.16 and UBC Standard 47-18. Mount in locations as indicated on the drawings as follows:

B. Surface/Suspended

1. Mount stem suspended fixtures on swivel hangers which are a standard catalog item of the same manufacture as the fixture. Provide one more hanger than the number of fixtures in the row. Coordinate degree of swivel with the ceiling slope.
2. Mount cable suspended fixtures with cable and hangers which are a standard catalog item of the same manufacture as the fixture. Cable hangers shall be adjustable for leveling the fixtures. Provide the number of hangers as recommended by the fixture manufacturer. Electrical feeds for cable suspended fixtures shall be with a coiled cord.
3. Mount surface fixtures at two support points. Provide 1-1/2" metal spaces for fixtures which occur on combustible ceilings. Submit spacer for approval.

C. Recessed

1. Coordinate recessed fixture locations with the acoustical tile pattern, concealed ductwork, piping, etc.
2. Check ceiling type (lay-in, gypboard, etc.) before ordering fixtures.
3. Fixtures installed in T-bar ceilings shall be supported as required by N.E.C.
4. All recessed fixtures (in accessible ceilings) shall be connected by means of a flexible conduit which is attached to a 4" square junction box. Box may serve more than one fixture.

D. Verify all measurements. Contractor is responsible for fixtures fitting in place in a satisfactory and workmanlike manner, to the approval of the Architect.

E. Contractor shall verify fixture locations with the Architectural Reflected Ceiling Plans, where such plans are provided.

END OF SECTION 265100

SECTION 270528 — RACEWAY AND BOXES FOR COMMUNICATIONS CIRCUITS

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. Provide all materials and labor for the installation of a pathway system for data and communications circuits. This section includes requirements for horizontal and building backbone raceways, fittings, and boxes specific to communications circuits (cabling) for voice and data.
- B. Related Sections:
 - 1. Division 26 Section — "Basic Electrical Materials and Methods"
 - 2. Division 26 Section — "Grounding and Bonding"
 - 3. Division 27 Section — "Inside Plant Communications Circuits"

1.3 REFERENCES

- A. Incorporate by reference the applicable portions of the following specifications, standards, codes into this specification section.
 - 1. General:
 - a. National Electrical Code (NEC)
 - b. National Electrical Safety Code (NESC)
 - c. Washington Industrial Safety and Health Act (WISHA)
 - d. Occupational Safety and Health Act (OSHA)

1.4 DEFINITIONS

- A. "EMT shall mean Electrical Metallic Tubing.
- B. "RMC" shall mean Rigid Metal Conduit.
- C. "Raceway" shall mean any enclosed channel for routing wire, cable or busbars.
- D. "Pullbox" shall mean a metallic box with a removable cover, used to facilitate pulling cable through conduit runs longer than 100' or in which there are more than 180 degrees of bends.
- E. "Junction box" shall mean a pullbox wherein a feeder conduit transitions to multiple distribution conduits.

1.5 SYSTEM DESCRIPTION

- A. Furnish, install, and place into satisfactory and successful operation all materials, devices, and necessary appurtenances to provide a complete Raceway system as hereinafter specified and/or shown on the Contract Documents. The Raceway system shall support an ANSI/TIA/EIA and ISO/IEC compliant communications Structured Cabling System (SCS) as specified in 271500 – Communications Structured Cabling.
- B. The work shall include materials, equipment and apparatus not specifically mentioned herein or noted on the Contract Documents but which are necessary to make a complete working Raceway system.

1.6 SUBMITTALS

- A. Product Data Submittals: Provide submittal information for review before materials are delivered to the job site. Provide product data submittals for all products at the same time.

1.7 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in NEC, Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation."
- C. Comply with NEC.

1.8 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials shall consist of conduit, outlet boxes, fittings, enclosures, pull boxes, and other raceway incidentals and accessories as required for inside plant communications circuits.

2.2 MATERIALS

- A. Conduit:
 1. EMT. 1" minimum conduit size. Flexible metal conduit (FMC) is not acceptable.
 - a. Conduit: Galvanized steel tubing meeting ANSI C80.3.
 - b. Couplings: Steel, cast iron, or malleable iron compression type employing a split, corrugated ring and tightening nut, with integral bushings and locknuts. Indent-type and setscrew-type couplings are not permitted.
 2. RMC. 1" minimum conduit size.
 - a. Conduit: Hot dipped galvanized steel with threaded ends meeting ANSI C80.1.

- b. Couplings: Unsplit, NPT threaded steel cylinders with galvanizing equal to the conduit.
 - c. Nipples: Same as conduit, factory-made up to 8 inches in diameter, no running threads.
- B. Sleeves: EMT conduit, with insulated throat bushings for each end
- C. Outlet boxes: Minimum 4"x4" size, 2 1/8" minimum depth, with extension rings (if needed) and single gang covers (i.e. mud rings), unless otherwise noted on the Contract Documents. Combined interior depth of outlet box, extension ring and cover shall be a minimum 2-1/2". Stamped steel, deep drawn one piece (without welds or tab connections), galvanized, with knockouts for 1" trade size conduit or connector entrance, meeting NEMA OS 1.
 - 1. Acceptable manufacturers:
 - a. Appleton, Raco, Steel City, or equal
- D. Junction Boxes and Pull Boxes: Stamped steel, deep drawn one piece (without welds or tab connections), galvanized, with knockouts for conduit or connector entrance. Boxes 6"x6"x4" or larger may be code gauge fabricated steel continuously welded at seams and painted after fabrication.
 - 1. Dry locations: meeting NEMA OS 1.
 - 2. Wet locations: NEMA OS 3R.
- E. Miscellaneous Fittings:
 - 1. Locknuts and conduit bushings: Malleable iron
 - a. Appleton, Crouse Hinds, OZ Gedney, or equal
 - 2. Through wall seals and floor seals shall be:
 - a. OZ Gedney FS and WS series.
- F. Pull Strings: Plastic or nylon with a minimum test rating of 200 lb.

2.3 FIRESTOPPING

- A. Material: Conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire test in a configuration that is representative of the actual field conditions. Manufactured by:
 - 1. Specified Tech. Inc.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor is solely responsible for the safety of the public and workers in accordance with all applicable rules, regulations, building codes and ordinances.
- B. All work shall comply with applicable safety rules and regulations including OSHA and WISHA. All work shall comply with the requirements of the National Electrical Safety Code (NESC) and the NEC except where local codes and/or regulations are more stringent, in which case the local codes and/or regulations shall govern.
- C. All work shall comply with the standards, references and codes listed in PART 1 -- REFERENCES above. Where questions arise regarding which standards, references, or codes apply, the more stringent shall prevail.

- D. All work shall comply with the requirements and recommendations of the product manufacturers. Where questions arise regarding which requirements and recommendations apply, the more stringent shall prevail.
- E. Install the raceway system in a manner ensuring that communications circuits, when installed, are able to fully comply with the ANSI/TIA/EIA and other references listed in Part 1 — References, above.
- F. Replace and/or repair to original (or better) condition any existing structures, materials, equipment, etc. inadvertently demolished or damaged by the Contractor during the course of construction at no additional cost to the Owner.
- G. Remove surplus material and debris from the job site and dispose of legally.

3.2 EXAMINATION

- A. Examine surfaces and spaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions. Provide a raceway for each circuit indicated. Do not gang raceway into wireways, pullboxes, junction boxes, etc., without specific approval from the Designer. Do not group home runs or circuits without approval from the Designer.
- B. Conduit:
 1. Install EMT unless other conduit is shown on the Contract Documents, is required by Code, or is permitted under these specifications.
 2. Install conduit as a complete, continuous system without wires, mechanically secured and electrically connected to metal boxes, fittings and equipment. Blank off unused openings using factory-made knockout seals.
 3. Run conduit in the most direct route possible, parallel to building lines. Do not route conduit through areas in which flammable material may be stored.
 4. Keep conduit at least 6 inches away from parallel runs of flues and steam or hot-water pipes or other heat sources operating at temperatures above one-hundred degrees Fahrenheit. Install horizontal conduit runs above water piping.
 5. Keep conduit away from sources of electromagnetic interference as follows:
 - a. 5 inches from fluorescent lighting
 - b. 12 inches from conduit and cables used for electrical power distribution
 - c. 48 inches from motors or transformers
 6. Do not exceed 90 meters total length for a given conduit run to be used for distribution cabling (from outlet box to telecommunications room), including intermediate conduits and junction boxes.
 7. Install conduit exposed, except in finished areas or unless shown otherwise on the drawings. Do not install conduit below grade/slab unless specifically shown on the Contract Documents as being installed below grade/slab.

8. Install exposed conduit in lines parallel or perpendicular to building lines or structural members except where the structure is not level. Follow the surface contours as much as practical. Do not install crossovers or offsets that can be avoided by installing the conduit in a different sequence or a uniform line.
 - a. Run parallel or banked conduits together, on common supports where practical.
 - b. Make bends in parallel or banked runs from same centerline to make bends parallel.
9. Conduits concealed above ceilings, furred spaces, etc., which are normally inaccessible may be run at angles not parallel to the building lines.
10. Wherever practical, route conduit with adjacent ductwork or piping and support on common racks. Base required strength of racks, hangers, and anchors on combined weights of conduit and piping.
11. Where conduits cross building expansion joints, use suitable sliding or offsetting expansion fittings. Unless specifically approved for bonding, use a suitable bonding jumper.
12. Support conduits as specified in Section 260500 "General Electrical Requirements"
 - a. Provide anchors, hangers, supports, clamps, etc. to support the conduits from the structures in or on which they are installed. Do not space supports farther apart than five feet.
 - b. Provide sufficient clearance to allow conduit to be added to racks, hangers, etc. in the future.
 - c. Support conduit within three feet of each outlet box, junction box, gutter, panel, fitting, etc.
13. Ream conduits to eliminate sharp edges and terminate with metallic insulated grounded throat bushings. Seal each conduit after installation (until cable is installed) with a removable mechanical-type seal to keep conduits clean, dry and prevent foreign matter from entering conduits.
14. Install a pull string in each conduit.
15. For conduits entering through the floor of a telecommunications room, terminate conduits 4 inches above the finished floor.
16. Do not install communications conduits in wet, hazardous or corrosive locations.
17. Where conduit is shown embedded in masonry, embed conduit in the hollow core of the masonry. Horizontal runs in the joint between masonry units are not permitted.
18. Where conduit is shown embedded in concrete, embed conduit a minimum of two inches from the exterior of the concrete. Do not place conduit in concrete less than five inches thick.
 - a. One inch trade size conduit shall be used. Conduits sized larger or smaller than one inch trade size conduit are not permitted embedded in concrete.
 - b. Run conduit parallel to main reinforcement.
 - c. Conduit crossovers in concrete are not permitted.
19. Where conduit exits from grade or concrete, provide a rigid steel elbow and adapter.
20. Where conduit enters a space through the floor and terminates in that space, terminate the conduit at 4" above the finished floor.
21. Where conduits terminate at a cable tray, the conduits shall be consistently terminated no more than 8" from the cable tray, and have a visually uniform appearance.
22. Where several circuits follow a common route, stagger pullboxes or fittings.
23. Where several circuits are shown grouped in one box, individually fireproof each conduit.
24. Bend and offset metal conduit with standard factory sweeps or conduit fittings. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
 - a. Conduit sweeps:
 - 1) Sweeps shall not exceed 90 degrees.
 - 2) Do not exceed 180 degrees for the sum total of conduit sweeps for a section of conduit (between conduit termination points).

- 3) Sweep radius shall be at least 10 times the internal diameter of the conduit.
 - 4) 90-degree condulets (LB's) and electrical elbows are not acceptable.
 - b. Factory-manufactured sweeps are required for bends in conduit larger than 1 inch trade size.
 - c. For bends in 1 inch trade size conduit, field-manufactured bends (using a hydraulic bender with a 1" boot) are permitted only when factory-manufactured sweeps are not suitable for the conditions. In all other cases, factory-manufactured sweeps are required. "Hickey-bender" use is prohibited.
25. Connect conduit to hubless enclosures, cabinets and boxes with double locknuts and with insulating type bushings. Use grounding type bushings where connecting to concentric or eccentric knockouts. Make conduit connections to enclosures at the nearest practicable point of entry to the enclosure area where the devices are located to which the circuits contained in the conduit will connect.
26. Penetrations for raceways:
- a. Do not bore holes in floor and ceiling joists outside center third of member depth or within two feet of bearing points. Holes shall be 1-¼ inch diameter maximum.
 - b. Penetrate finished walls and finished surfaces with a PVC or sheet metal sleeve with an interior diameter (ID) at least 1/4" greater than the outer diameter (OD) of the conduit, set flush with walls, pack with fiberglass, seal with silicone sealant and cover with escutcheon plate.
 - c. Penetrate poured-in-place walls and free slabs with a cast iron sleeve (or Schedule 40 PVC black pipe sleeve for above-grade only) with retaining ring or washer. Set sleeves flush with forms or edges of slab. Pack around conduit with fiberglass and seal with silicone sealant.
27. Raceway terminations and connections:
- a. Join conduits with fittings designed and approved for the purpose and make joints tight. Do not use set indent-type or screw-type couplings.
 - b. Make threaded connections waterproof and rustproof by applying a watertight, conductive thread compound. Clean threads of cutting oil before applying thread compound.
 - c. Make conduit terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - d. Cut ends of conduit square using a hand saw, power saw or pipe cutter. Ream cut ends to remove burrs and sharp ends. Where conduit threads are cut in the field, cut threads to have same effective length, same thread dimensions and same taper as specified for factory-cut threads.
 - e. Provide double locknuts and insulating bushings at conduit connections to boxes and cabinets. Align raceways to enter squarely and install locknuts with dished part against the box. Use grounding type bushings where connecting to concentric or eccentric knockouts.
 - f. Where conduits are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

28. Install conduit sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - a. Where conduits pass from warm to cold locations, such as the boundaries of air conditioned or refrigerated spaces and where conduits enter or exit buildings from outdoor areas, including underground ducts or conduit runs.
 - b. Where otherwise required by the NEC.
 29. Conduit shall be clean and dry.
- C. Sleeves:
1. Provide sleeves where required, sized as noted on the Contract Documents. Where not noted, sleeve sizing shall be determined by the type and quantity of cable to be routed through the sleeve per TIA/EIA 569A cable capacity standards, plus an additional 100% for future expansion.
 2. Provide roto-hammering or core drilling where required for installation.
 3. Seal between sleeve and wall or floor in which the sleeve is installed. Firestop penetration to restore wall or floor to pre-penetration fire-rating.
- D. Outlet Boxes:
1. Provide outlet boxes and covers as shown on the Contract Documents and as needed. Verify that the appropriate cover type and depth is provided for each type of wall and finish. Provide extension rings as needed.
 2. Coordinate box locations with building surfaces and finishes to avoid bridging wainscots, joints, finish changes, etc.
 3. Install boxes in dry locations (not wet, corrosive, or hazardous).
 4. Attach boxes securely to building structure with a minimum of two fasteners. Provide attachments to withstand a force of one hundred pounds minimum, applied vertically or horizontally.
 5. Install boxes at the following heights to the bottom of the box, except where noted otherwise:
 - a. Wall mounted telephones: 46 inches above finished floor.
 - b. Workstation outlets: 16 inches above finished floor.
 - c. Place boxes for outlets on cabinets, countertops, shelves, and similar boxes located above countertops two inches above the finished surface or two inches above the back splash. Verify size, style, and location with the supplier or installer of these items prior to outlet box installation.
 6. Recessed mounted outlet boxes:
 - a. Recess boxes in the wall, floor, and ceiling surfaces in finished areas. Set boxes plumb, level, square and flush with finished building surfaces within one-sixteenth inch for each condition. Set boxes so that box openings in building surfaces are within one-eighth inch of edge of material cut-out and fill tight to box with building materials. Single gang opening shall extend at least to the finished wall surface and extend not more than 1/8 inch beyond the finished wall surface. Provide backing for boxes using structural material to prevent rotation on studs or joists.
 - b. Install floor boxes level and adjust to finished floor surface.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and in accordance with accepted industry practice, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

- 1. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 270528

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, and all drawings and specifications of this Division 28, apply to work specified in this section.

1.2 SUMMARY

- A. Provide a complete, constantly supervised, analog addressable, battery-backed fire alarm system with audible and visual signals for evacuation and a digital interface for connection to existing campus fiber optic cable network system to communicate to a central monitoring agency.
- B. The entire system shall fully comply with all fire codes currently enforced at the project location. If any conflict occurs between the codes and these contract documents, the code shall govern. This does not relieve the contractor of complying with any requirements of the plans and specifications which are in excess of the codes.
- C. The control panel shall support the future addition of notification appliances, manual stations, heat detectors, smoke detectors, fire sprinkler monitoring devices and control relays.
- D. Program the fire alarm system in accordance with requirements of the Authority Having Jurisdiction (AHJ) and directions received from the Owner's Representative.
- E. Adjust and test the fire alarm system, demonstrate the system to the authority having jurisdiction, and instruct the Owner's staff in operation and recommended maintenance procedures.

1.3 GENERAL DESCRIPTION

- A. System shall consist of control cabinets with system modules, relays, battery backup, annunciators and control switches, appliance extender panels, remote annunciators, remote control panels, manual stations, heat detectors, smoke detectors, duct smoke detectors, audible and visual alarm signals, exterior bell, control relays, central station communicator and all other miscellaneous equipment required for a complete operable system which complies with all applicable codes and standards.
- B. The system components and system installation shall comply with NFPA 72 and the International Fire Code.

1.4 SYSTEM OPERATION

- A. Each initiating and signal circuit shall be electrically supervised for opens, shorts, and ground faults in the wiring. The occurrence of any fault shall activate the system trouble circuitry but shall not interfere with the proper operation of any circuit that does not have a fault condition. Initiating circuits shall be wired using Class "B" supervised circuits. Signal circuits shall be Style "Y" supervised circuits.

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- B. The alpha-numeric display at the control panel, remote control panels and remote annunciators shall indicate the following information relative to the abnormal condition of any point within the system:
 - 1. Minimum 32-character custom label (device location and address).
 - 2. Type of device (heat, manual, waterflow, etc.).
 - 3. Point status (alarm, supervisory, trouble).
- C. The activation of a manual station, heat detector, area smoke detector, or any other alarm initiating device shall cause the following operations:
 - 1. Display an alpha-numeric device description on the control cabinet door.
 - 2. Activate all audible and visual alarm signals.
 - 3. Release all magnetically-held and electrically-held hinged doors.
 - 4. Close all motorized fire doors.
 - 5. Release all exit doors controlled by electric locks for access control
 - 6. Cause all electrically-operated security closures occurring in the path of egress to open.
 - 7. Provide a dry contact closure for the Energy Management System.
 - 8. Report alarm condition to an approved Central Reporting Agency via telephone.
- D. Duct smoke detectors shall not activate a general evacuation alarm. A "supervisory" condition shall be initiated by the activation of duct smoke detectors.
- E. Upon activation of a duct smoke detector located in the supply or return air ducts associated with an air handling unit, the fire alarm system shall shut down the associated air handling equipment.
- F. Upon activation of a duct smoke detector or a corridor smoke detector, the fire alarm system shall shut down the associated air handling equipment and close down all associated smoke dampers, in addition to causing the aforementioned operations. The associated dampers shall also close any time the air handling equipment is shut down for any reason.
- G. Upon activation of a smoke detector adjacent to an air transfer duct, the fire alarm system shall close the associated smoke damper, in addition to causing the aforementioned operations.
- H. Upon activation of a ceiling-mounted smoke detector adjacent to a magnetically-held, overhead rolling fire door, the fire alarm system shall cause the adjacent door to close, in addition to causing the aforementioned operations. Rolling fire doors shall not close on any other fire alarm condition.
- I. Magnetically-held and electrically-held hinged doors shall be released, electric locks on exit doors shall be released, motorized fire doors shall close and electrically-operated security closures shall open during fire alarm system tests and drills. Magnetically-held overhead rolling fire doors shall not be released during fire alarm system tests or drills.
- J. Alarm devices may be silenced only by operating the proper "acknowledge" switch. Operation of the switch shall silence the audible signals only, and place the flashing alarm and/or trouble LED's in a continuously illuminated condition. Subsequent activation of any alarm initiating device shall reactivate the alarm sequence. Restoring the initiating device to normal shall permit operation of the "reset" switch, thereby placing the system back to normal.

- K. A “supervisory” condition shall be initiated under any of the following circumstances:
 - 1. Tamper switch not in normal position.
 - 2. Activation of duct smoke detector.
 - 3. Activation of a heat detector in the elevator shaft or the elevator machine room
 - 4. Manual fan shut-down through the fire alarm system.
- L. A “trouble” condition shall be initiated under any of the following circumstances:
 - 1. Open, short or ground on an initiation circuit.
 - 2. Open, short or ground on a signal circuit.
 - 3. Ground on any DC power line within the system.
 - 4. Removal of a control module.
 - 5. Removal of an alarm initiating device from its base.
 - 6. Smoke detector compensated beyond acceptable limits.
 - 7. Loss of normal building power.
 - 8. Loss of battery or auxiliary power.
 - 9. Loss of campus network communication.
- M. Supervisory and trouble conditions shall indicate visually with separate LED’s, and audibly with a sounding device in the control panel. Audible signals shall be distinct for supervisory and trouble conditions. Distinct supervisory and trouble signals shall also be transmitted to the Central Reporting Agency. Device and zone shall be identified on Control Panel annunciators and remote annunciators.
- N. Alarm, supervisory and trouble conditions shall be available for chronological review on the display at the control panel.
- O. System shall use building power for primary operation, with automatically charged, sealed maintenance-free batteries as secondary power. Batteries shall have capacity to operate the entire system, including central reporting communicator for 60 hours and operate all audible and visual signals for 5 minutes at eh end of the 24-hour period. Batteries shall automatically charge to 80% of full charge within 8 hours.
- P. The control circuits to door holders for hinged doors shall be arranged so that they are automatically disconnected from the system power supply upon loss of 120 volt A.C. building power.

1.5 SPECIAL FEATURES

- A. Alarm Verification: System software shall utilize a false-alarm prevention technique which shall retard the alarm for all smoke detectors. The system shall have the capability of assigning smoke detectors of up to eight (8) different verification groups. Alarm initiating devices other than smoke detectors shall initiate an immediate alarm. Smoke detectors shall initiate a pre-alarm indication for a 35-second interval, after which the control panel shall reset the detector. Activation of any other initiating device within 60-seconds, whether in the same verification group or not, shall initiate an immediate system alarm. A second alarm condition from the same device within the 60-second confirmation period shall also initiate a system alarm condition.

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- B. Addressable, Analog Smoke Sensors: System software shall automatically adjust each analog smoke sensor approximately once each minute for changes in sensitivity due to the effects of component aging, environmental conditions and accumulation of dust. Each smoke sensor shall maintain its sensitivity at the pre-selected level. Sensitivity shall be programmed and displayed in percent obscuration –per foot. The system shall automatically report a “dirty detector” trouble condition prior to the detector reaching the point where its sensitivity can no longer be maintained at the selected level. If the detector reaches the point at which the detector sensitivity can no longer be maintained at the preselected value, an “excessively dirty detector” trouble condition shall be reported. By appropriate manipulation of the panel keypad, it shall be possible to command the system to display or print a list of detectors that are within 10 analog units of reaching “dirty detector” status. The system shall monitor the peak value reported by each detector, and shall display or print this information for all detectors upon command.
- C. Smoke Sensor Testing: System software shall automatically test each analog smoke sensor a minimum of once every five (5) seconds. The test shall be a recognized functional test of each photocell as required annually by NFPA 72. Failure of an analog smoke sensor shall activate the system trouble circuitry, display a “Test failed” indication, and identify the individual detector.
- D. Walk Test: The control unit shall provide a dual-mode walk test program which shall enable one person to test the alarm/supervision status of each initiating device connected to the system. The walk test program shall include both an audible mode and a silent mode, each of which shall permit test data to be recorded to a printer for historical reference. During walk test, the control unit shall automatically reset after an alarm condition, enabling the testing technician to continue testing the system without requiring a return to the control panel. Walk test shall not activate elevator recall, shut down mechanical equipment, release electrically-held overhead doors or activate central reporting.

1.6 SUBMITTALS

- A. Product Data: For all equipment, addressable devices, signal devices, peripheral devices and cable.
- B. Show Drawings: Battery calculations, volt-drop calculations, tap settings, floor plans, wiring diagram and operational matrix.
- C. In addition to submitting the above information to the Architect for review, the same information shall also be submitted to each code-enforcing authority as required to obtain approval. Pay all review, permit and inspection fees required for approval of the fire alarm system work.

1.7 INFORMATION FOR O&M MANUAL

- A. Submittals: Information submitted for review, up-dated to record any changes.
- B. Test Reports: Record of all field test data.
- C. Operation Instructions: Supply a detailed narrative description of the system operation. Indicate expansion capability, application conditions and limitations of use. Include manufacturer’s installation, operating and programming instructions.

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- D. Maintenance Instructions: List replacement parts, including source. Indicate recommended and required maintenance and testing procedures, and the intervals involved for each. List all individual system components that require periodic maintenance. Detail trouble-shooting procedures, including step-by-step instructions for all trouble signals annunciated by the system. Furnish service directory with names and telephone numbers to obtain service.
- E. Certificates: Record of Completion in completed form.
- F. Warrantee: Manufacturer's warranty certificate.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Control Panel: The control panel shall be microprocessor-based and continuously supervised, with modular circuit board construction. It shall have capacity for 100 points of addressable devices. The unit shall be housed in a cabinet with a hinged lockable door. The cabinet shall be arranged for semi-flush mounting. In addition, the control panel shall include the following features:
 - 1. Control Features: Acknowledge, silence, and reset controls. Subsequent alarms shall activate all alarm functions if system is in "silence" mode. Control panel shall also include four (4) auxiliary multi-function switches, each with its own status LED. Auxiliary switches shall be labeled as follows:
 - a. Spare
 - b. Spare
 - c. Spare
 - d. Spare
 - 2. Annunciator: Alpha-numeric LCD display, 64-character minimum, which shall indicate all alarm signals received until the condition is cleared and the system is reset. A power-on indicator shall be included. The annunciator shall also include dedicated LED's and a tone alert for alarm, supervisory and trouble conditions, with an acknowledge push-button to silence the tone alert, but leave the LED illuminated until all conditions in that category are restored to normal. The tone alert shall sound again after a pre-selected time interval if the acknowledged abnormal condition is not corrected. Annunciator shall have the capability to store and recall multiple alarms. Annunciator shall display alarm zone as well as individual device location and description. All indicators shall be visible with the door closed through breakage resistant windows in the door of the control cabinet.
 - 3. Input Modules: Addressable circuits capable of mixing addressable and analog devices on the same zone and differentiating between the two for different software operations. Sufficient initiating device modules shall be provided to receive input from 150% of all initiating devices, to enable additional devices to be added easily.
 - 4. Signal Controller: Sufficient notification appliance modules shall be provided to operate 150% of all signal devices. Provide additional appliance extender panels as required to fulfill this requirement. The control panel shall provide a temporal audio/visual code as required by Uniform Fire Code Standard 10-2. The control panel shall provide a synchronization signal to coordinate timing of self-synchronized visual strobes.
 - 5. Output Relays: Sufficient Form C auxiliary relays with 2 amp contacts to accomplish indicated control functions, plus two (2) alarm contacts, two (2) supervisory contacts, two (2) trouble contacts, and four (4) spare relays.

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6. City Reporting: City reporting circuit, field selectable for reverse polarity, shunt, or local energy types of transmission.
7. System Processors: Multiprocessor type to allow each I/O functional module to hold and execute its own microprocessor software program under the control of the main system microprocessor. A common RS-485 style communications network shall tie all I/O functional modules in an integrated internetwork affording true distributed processing of all system operations. Each network-interconnected module shall have its own processor and memory.
8. RS-232 Interface Module: Provide modular interface board with two (2) isolated RS-232 ports. One port shall be for a printer. The other port shall be usable either for programming via a CRT/keyboard terminal.
9. System Software: Field-programmable and retained in non-volatile system memory. Control shall be programmable through the use of a built-in display and programming switches on the system control panel and individual input and output circuits including zones, notification circuits and relays. Programming shall be password protected and shall not require the use of an additional programming appliance or tool. Control shall also be programmable through the use of a dedicated software package. The system configuration shall be saved to 3-1/2" disks for field program modification without the addition of programming hardware. While in the programming mode, the control panel shall provide a fire alarm override to assure that all alarms will be annunciated. Initial programming by factory-authorized technicians shall be included. A paper copy and an electronic copy of the final system configuration including all inputs, outputs, descriptions, addresses, and programming matrixes, shall be included in the Operations and Maintenance Manuals.
10. Programming Port: An isolated RS-232 serial port shall be provided for connection of a laptop computer to facilitate system programming.
11. Serial Output Port: A supervised RS-232C serial port shall be provided to operate remote printers and CRT's to provide an 8-column readout of all alarms, troubles, location descriptions, time, and date. The communication shall be standard ASCII code operating at 1200 baud minimum.
12. Power Supply: Include batteries and charger, sized appropriately to handle device loading, and provide the duration of back-up power specified herein. Batteries shall be automatically supervised for proper charge levels and connection. Power supply shall include MOV transient protection per UL Standard 864 requirements. The control panel shall be UL-listed for power-limited application per NEC Article 760.
Appliance Extender Panels: Provide notification appliance circuit (NAC) power extender panels as required to power all signal devices. Each panel shall connect as an end-of-line device to a compatible, dedicated notification appliance circuit (NAC) from the control panel. Alarms from the control panel shall be extended to four (4) supervised Style Y signal circuits. If required, an additional 4-circuit module shall be added to allow separate control of audible and visual appliances or combining all eight circuits on a common control. Circuits shall maintain synchronization of visual signals. The unit shall include batteries and charger, sized appropriately to handle device loading and provide the duration of back-up power specified herein. Batteries shall be automatically supervised for proper charge levels and connection. Power supply shall include MOV transient protection per UL Standard 864 requirements. The central station communicator shall be UL-listed for power-limited application per NEC Article 760. Cabinet shall be arranged for surface mounting.

2.2 ADDRESSABLE DEVICES

- A. Manual Stations: Addressable single-action type, requiring an outer door to be lifted to expose the actuator door. Upon the pulling forward of the actuator door, the unit shall lock into a readily observable alarm position. Manual stations shall be constructed of aluminum. Each manual station shall require a key to reset the actuated station. Manual stations shall be keyed to match control panels.
- B. Heat Detectors: Analog addressable dual-element type. Each detector shall include a fixed temperature element and a rate-of-rise element. Fixed temperature element shall be set at 135 degrees F except where a 200 degree F element is specifically indicated. Finish shall be white.
- C. Smoke Detectors: Analog addressable photoelectric type. Smoke detectors located above ceilings, and in other locations where remote indicators are required, shall be equipped with auxiliary contacts rated 2 amps at 120 volts. Smoke detectors that are directly connected to door release circuits shall be UL listed for such use. Finish shall be white.
- D. Duct Smoke Detectors: Analog addressable photoelectric type, equipped with baffle, housing and two sampling tubes. Detector shall include auxiliary contacts rated 2 amps at 120 volts for remote indicator. Sampling tubes shall be sized to match the duct opening.
- E. Monitor Modules: Addressable module for monitoring peripheral non-addressable initiating devices, such as water-flow switches and supervisory tamper switches. Provide sufficient addressable monitor modules to provide addresses for all normally-open (N.O.) contact-initiating devices.
- F. Control Modules: Output modules for connection to the same addressable loop as the addressable monitor devices. Control modules shall provide a Form C contact, rated 2 amps at 120 volts A.C. Provide control modules where necessary to provide a relay output for releasing door holder circuits, shutting down fans, and similar control functions.
- G. Signal Modules: Output modules for connection to the same addressable loop as the addressable monitor devices. Signal modules shall provide a Form C contact, rated 2 amps at 120 volts A.C. Provide signal modules where necessary to provide a Style Y supervised notification circuit.

2.3 SIGNAL DEVICES

- A. General: Alarm signals shall comply with UL 1971, UL 1638, and the Americans with Disabilities Act (ADA). Audible signals shall sound in accordance with a Code 3 temporal pattern. Strobes shall have a flash rate of 1 hertz. Wherever more than one visual signal is visible from any one location, all visual signals shall be self-synchronized. At a minimum, the strobe intensity shall be 15 candela minimum, with a near-axis intensity exceeding 75 candela. Where so indicated or here required to comply with the aforementioned standards, increased minimum strobe intensities of 30 candela, 75 candela and 110 candela shall be provided.
- B. Audible/Visual Alarm Signals: Audible signals shall be horns that shall provide a selectable sound level consisting of at least two levels separated by a minimum of 4 dB within the range of 89 to 99 dBA, as measured at a distance of 10 feet from the horn on axis. Visual signals shall have xenon strobes behind protruding clear lenses with the word "FIRE" in red letters on two sides. Audible and visual signals shall have a common faceplate, and shall be designed to be mounted on a common flush-mounted backbox. Finish shall be white.

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- C. Visual Alarm Signals: Xenon strobes behind protruding clear lenses with the word "FIRE" in red letters on two sides. Visual signals shall be designed to mount on a flush-mounted backbox, and shall match the audible/visual signals in appearance. Finish shall be white.

2.4 PERIPHERAL DEVICES

- A. Isolated Loop Circuit Protectors: Transient protector with response time less than 5 nano-second line-to-line and 25 nano-seconds line-to-ground, capable of accepting an 8x20 micro-second pulse of up to 2000 amps and shunting it to ground. The circuit protector shall be small enough to mount in a 4-11/16" square by 2-1/8" deep box.
- B. Interface Relays: SPDT with coil rated 24 volts A.C. or D.C. and contacts rated 10 amps at 120 volts A.C. Relay shall be suitable for installation on a supervised circuit, and shall include an LED that illuminates when the relay is activated. Relay shall be self-contained in its own NEMA Type 1 enclosure.
- C. Remote Indicators: Appropriately labeled LED and key operated test switch on a single-gang device plate.
- D. Magnetic Hold-Open Devices: Die-cast metal housing with high-luster finish, 35-pound holding force minimum, with dual 24 volt AC/DC and 120 volt AC coils. Unit shall have low residual magnetism. Current draw shall not exceed 0.020 mA. Provide extension accessories where distance to wall exceeds the standard device depth. Finish shall be chrome or brass, as selected by the Architect.

2.5 WIRE AND CABLE

- A. General: Wire size shall be minimum 14 AWG, except communications cable. Power and grounding conductors shall be minimum 12 AWG. All wire and cable shall be suitable for Fire Protective Signaling Circuit use. Minimum insulation rating shall be 300 volts. Cable shall be rated FPL.
- B. Addressable Loop Cable: Shielded 18 AWG FPLR twisted-pair cable with drain wire and over-all jacket.

2.6 ACCEPTABLE MANUFACTURERS:

- A. System: Simplex 4100-U series, Siemens MXL series, Edwards EST3 series, Gamewell 600 series, FCI 7200 series, Silent Knight Farenhyt IFP series. No others.
- B. Suppliers: Simplex/Grinnell of Spokane, Fire Power of Spokane, ECS, EVCO, Allied Security, Fire Systems West of Spokane.
- C. Signal Appliances: Wheelock or system manufacturer.
- D. Isolated Loop Circuit Protectors: Northern Technologies, Ploy-Phaser or system manufacturer.
- E. Interface Relays: Air Products or system manufacturer.
- F. Protective Covers: Safety Technology or system manufacturer.

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- G. Security Guards: Chase Security or system manufacturer.
- H. Cable: Alpha, Belden, Carol, West Penn.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning rough-in for the fire alarm system, the Contractor shall arrange a pre-installation meeting on the site between all parties involved in the fire alarm system installation, including the Fire Alarm System Vendor, the Fire Alarm System Installer and the Electrical Systems Installer. All parties shall review the fire alarm system shop drawings, the manufacturer's installation instructions, applicable codes and standards, the requirements of the local AHJ and any site conditions pertinent to installation of the fire alarm system.

3.2 INSTALLATION

- A. Installation shall conform to the wiring diagrams submitted as shop drawings and to the manufacturer's instructions, recommendations and precautions.
- B. Installation of equipment, devices, wire and cable, including terminations, programming, adjusting, testing and demonstration shall be performed by an installer qualified to perform fire alarm system work, as specified herein.
- C. Final connections between the wiring system and the equipment shall be made under the supervision of a representative of the equipment manufacturer. Equipment shall not be energized until all connections have been approved by said representative.
- D. Fire alarm equipment and devices shall be protected from dust during construction. Smoke detector heads shall be installed only after dust-producing activities have completely ceased, building surfaces have been finished and clean-up by trades has been completed. The plastic covers shipped with the detectors are for protection during shipping and storage, and are not suitable to protect detectors from construction dust.
- E. Provide backboxes matched to the device or equipment in all cases. Backboxes and cabinets shall be plumb and perfectly aligned.
- F. All wiring shall be installed in a metallic raceway system arranged as shown on the Fire Alarm shop drawings. The conduit arrangement shown on the Contract Drawings is illustrative only, and shall not relieve the Contractor from responsibility to provide separate conduit for wiring connected to different class power supplies in accordance with NEC Article 760.
- G. Maintain consistent color-coding of conductors throughout the project per Fire Alarm shop drawings. Wiring in cabinets and terminal boxes shall be neatly arranged and bundled with nylon wire ties.
- H. Provide isolated loop circuit protectors on all initiating, indicating and signaling circuits extending beyond the building perimeter, including addressable loop and annunciator communications lines and associated shielding. Locate the protectors as close as practical to the point where the circuits enter and leave the building. Connect the ground terminal or protector to the building grounding system with a grounding conductor no smaller than 12 AWG.

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- I. Locate ceiling-mounted smoke detectors at least 48" from supply air diffusers, and at least 12" from return air grilles. Smoke detectors intended for door release shall be located on the ceiling not more than 60" away from the door.
- J. Locate duct smoke detectors in straight lengths of duct where they will be readily accessible for maintenance and cleaning. Avoid locations near duct openings, connections to branch ducts and duct turns. Arrange duct smoke detectors and sampling tubes to monitor the entire duct per the manufacturer's recommendations. Where sampling tube length exceeds 3 feet, support tube at opposite end from duct smoke detector. Where this requirement cannot be fulfilled with a single detector, provide additional duct smoke detectors as required for proper operation.
- K. Install duct smoke detectors after the interior of the ductwork is clean and free of dust. Seal tightly at point of duct penetration and repair insulation.
- L. Where smoke detectors or duct smoke detectors are located above ceilings or otherwise are not readily visible, provide remote indicator lights equipped with key operated test switches. Provide a permanently attached placard indicating the location of the detector and the area served.
- M. The specified alarm signals and their placement on the drawings are intended to be appropriate to achieve the required level of audibility and visibility. It shall be the responsibility of the System Vender to assure himself that the design is adequate per applicable codes. If additional signals are required to meet code standards they shall be provided at no additional cost to the Owner.
- N. Provide and connect interface relays as required to accomplish control functions included in the description of system operation. Control relays shall be located within 36" of the device or controller that is to be controlled, except in the case of door holders for hinged doors, which is considered a fail-safe requirement. The purpose of this requirement is to provide supervision of the control circuit up to the interface relay.
- O. Install magnetic door holders and connect them to the fire alarm system.
- P. Connect miscellaneous peripheral devices to the fire alarm system, including sprinkler water flow switches, supervisory tamper switches, kitchen hood control panels, fire suppression systems and similar equipment.

3.3 MOUNTING HEIGHTS

- A. Backboxes shall be mounted at the heights noted on the drawings. Where not otherwise indicated, the following mounting heights shall be observed:
 - 1. Manual Stations – as indicated on the Drawings.
 - 2. Alarm Signals – as indicated on the Drawings.
- B. Remote indicators shall be installed in a visible location in the immediate vicinity of the device for which it provides indication. Where the ceiling is not over 10'-0", mount on the wall at a uniform height at least 90" above the floor.
- C. Magnetic door holders shall be installed 2" from end of door swing near top of door. Align each magnetic door holder with the matching plate on the door, so they will meet perfectly when the door is in the open position. Coordinate locations with relites and other architectural features.

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3.4 ADJUSTMENT, TESTING AND PROGRAMMING

- A. The fire alarm system shall be programmed to function as specified under the description of system operation, including special features. Programming shall comply with requirements of the AHJ and with direction received from the Owner's Representative.
- B. Programming shall be performed by an authorized manufacturer's representative.

3.5 ADJUSTMENT, TESTING AND DEMONSTRATION

- A. Coordinate with the Commissioning Agent to witness testing. Refer to Specification Section 019113 for additional information on commissioning.
- B. Records of all tests, including expected test results, actual test results, and corrective actions taken, shall be maintained during testing and shall be submitted by the Contractor.
- C. Test all fire alarm system wire and cable after installation and prior to connection to equipment. Tests to be performed shall include, but not be limited to, the following:
 - 1. Conductor continuity.
 - 2. D.C. insulation resistance.
 - 3. Freedom from shorts and grounds.
- D. Adjust taps on audible signal devices to produce a minimum sound level 15 dBA above the expected average ambient room sound level when the room is occupied, and 5 dBA above the expected peak ambient sound level.
- E. Test all system features for proper function. Tests shall be conducted by a manufacturer's representative after the system has been connected to the central monitoring agency. Notify the central monitoring agency prior to the tests. Tests to be performed shall include, but not be limited to, the following:
 - 1. Simulate supervisory and trouble conditions and verify operation.
 - 2. Verify proper operation of each manual station and each heat detector.
 - 3. Verify proper operation of each duct smoke detector by test button or magnetic actuation.
 - 4. Verify proper operation of each ceiling smoke detector by simulating smoke.
 - 5. Verify proper operation of peripheral devices.
 - 6. Verify proper annunciation of each alarm, trouble and supervisory condition.
 - 7. Verify proper operation of each door-closing device while testing the associated detectors.
 - 8. Verify proper operation of the shut-down sequence for each air handling unit while testing the associated detectors.
 - 9. Verify proper operation of each smoke damper while testing the associated detectors.
 - 10. Verify proper operation of elevator recall while testing the associated detectors.
 - 11. Verify proper operation of each control device on all control panels.
 - 12. Verify proper operation of each alarm signal device.
 - 13. Furnish documentation that all alarm, supervisory and trouble conditions were correctly reported to the central monitoring agency.
- F. Any deficiencies discovered as a result of the above testing shall be corrected and the Work affected by such deficiencies shall be completely retested at the Contractor's expense.

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- G. After the complete system has been tested and is operating properly, the manufacturer's representative shall test and demonstrate each fire alarm device and function in the presence of the Authority Having Jurisdiction (AHJ) as required to obtain approval of the system. Any additional programming, adjustment or testing required by the AHJ shall also be performed by the manufacturer's representative at no additional expense.
- H. Notify the Owner's Representative and the Commissioning Agent, at least one (1) week in advance of the dates when the above testing and demonstration will be performed, so that they may witness the tests.
- I. Instruments, gauges, testing equipment, protective devices and safety equipment for all testing shall be provided by the Contractor.

3.6 TRAINING

- A. The Contractor shall provide two (2) hours minimum of training for the Owner's staff in the operation of the fire alarm system. In addition, the Contractor shall provide four (4) hours minimum of further training for the Owner's maintenance personnel in the maintenance of the fire alarm system. Training time shall be extended as necessary to satisfy the Owner's representative that all pertinent topics have been adequately covered.
- B. The training shall be conducted after the O&M manuals for the project are completed and available for use during the training session.
- C. A training plan shall be submitted in advance for acceptance. The training plan shall outline the topics to be covered, the publications to be used, and the training schedule.
- D. The training shall be conducted by a representative of the equipment manufacturer who is thoroughly familiar with the equipment and its features, and also with the installation on this project. The training shall include instruction and over-the-shoulder hands-on training. As a minimum, the training shall cover, but not be limited to, the following topics:
 - 1. General overview of system features, including expansion capability.
 - 2. interpretation of system outputs (signal tones, annunciator displays, printouts, etc.)
 - 3. Operation of system controls (fire drill, acknowledge, silence, reset, etc.)
 - 4. Programming of system.
 - 5. Recommended and required maintenance procedures and intervals.
 - 6. Detailed trouble-shooting instructions for each trouble condition annunciated by the system.
 - 7. Explanation of service agreement options.

3.7 RECORD OF COMPLETION

- A. The Contractor shall certify completion of the fire alarm system installation and testing in accordance with the plans approved by the AHJ, the manufacturer's instructions and applicable codes and standards. Written certification shall be submitted to the AHJ at completion of each phase of the Work in accordance with NFPA 72, Article 1-7.2. Once final approval of the entire fire alarm system is obtained from the AHJ, the original copy of all Record of Completion certificates, together with the requisite Inspection and Testing Forms, shall be delivered to the Owner's Representative and photocopies shall be included in the O&M Manuals.

END OF SECTION 283111

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition.
- C. Any inconsistency in this section shall be resolved by application of the WSDOT Standard Specifications, most recent edition.
- D. Contractor shall conform to the recommendations outlined in the geotechnical report prepared by Grant County dated April 7, 2010. If the geotechnical report conflicts with these specifications contractor shall adhere to the more stringent.

1.2 SUMMARY

- A. Section Includes:
 - 1. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, removing site utilities and abandoning site utilities in place.
 - 7. Temporary erosion- and sedimentation-control measures.
- B. Related Sections:
 - 1. Division 01 Section "General and Supplementary Conditions" for the Geotechnical Report prepared by Grant County.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

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- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. All stripped topsoil and other excavated native materials shall be relocated or stockpiled on-site per the grading plan and will remain Owner's property.

1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify "One Call" for the area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- D. Soil Stripping, Handling, and Stockpiling: Advise to perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."
 - 1. Any new soils to be used on site must meet structural fill requirements as detailed in Division 31 Section "Earth Moving."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. Locate, identify, and disconnect utilities indicated to be capped or otherwise plugged with concrete.
- D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

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1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to meet structural fill compaction requirements.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to a maximum depth of 8 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water.
 1. Stockpile surplus topsoil on-site to allow for respreading. Spread all excess top soil in a uniform lift over all disturbed areas prior to seeding. Coordinate with Landscape plans for seed mixture.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
- C. Where removal creates depressions deeper than 6 inches, fill and compact depression per structural fill requirements.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them as directed by the Owner.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTH MOVING

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. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition. Except for the payment section.
- C. Any inconsistency in this section shall be resolved by application of the WSDOT Standard Specifications, most recent edition except for payment.
- D. Contractor shall conform to the recommendations outlined in the geotechnical report prepared by Grant County dated April 7, 2010. If the geotechnical report conflicts with these specifications contractor shall adhere to the more stringent.

1.2 SUMMARY

- A. Section Includes:
 - 1. Preparing subgrades for slabs-on-grade, walks, pavements and turf and grasses.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage course for concrete slabs-on-grade.
 - 4. Subbase course for concrete walks and pavements.
 - 5. Base course for asphalt paving.
 - 6. Subsurface drainage backfill for walls and trenches.
 - 7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
- B. Related Sections:
 - 1. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
 - 2. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.

1.3 DEFINITIONS

- A. Backfill: Approved structural backfill materials used to fill an excavation. Materials to comply with geotechnical report prepared by Grant County, dated April 7, 2010.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

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- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 24-inch wide, maximum, short-tip-radius rock bucket; rated at not less than 140-hp flywheel power with bucket-curling force of not less than 28,000 lbf and stick-crowd force of not less than 18,500 lbf with extra-long reach boom; measured according to SAE J-1179.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Controlled low-strength material, including design mixture.

- B. Qualification Data: A qualified testing agency according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
- C. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 1557.

1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify "One Call" for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. It is anticipated that the majority of existing site soil will not be satisfactory.
- B. Satisfactory Soils: Approved materials vary with structural fill applications across project site:
 - 1. Non-Structural Fill: Any area that will not contain structures (typically landscape areas).
 - a. Soils must be classified as GP, GM, GW, GC, SP, SM, SW, SC, CL or ML according to the USCS.
 - b. Soil may not contain particles larger than 12-inches in median diameter.
 - c. Soil must be reasonably free from deleterious substances such as wood, metal, plastic, waste, etc.
 - 2. Crushed Aggregate (includes both Base Course and Top Course crushed aggregate per WSDOT Standard Specification section 9-03.9(3) Crushed Surfacing): Embankments, structural fill, over excavations, pavement section aggregate, wall backfill, foundation and slab support, soil improvements.

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- a. Soil must contain less than 3 percent (by weight) of organics, vegetation, wood, metal, plastic or other deleterious substances.
3. Drainage Course (drain rock): To be used in all drainage systems.
 - a. Must meet requirements in WSDOT Standard Specification Section 9-03.12(5) Gravel Backfill for Drywells.
- C. Unsatisfactory Soils: Soil Classification Groups OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 1. Unsatisfactory soils also include:
 - a. Satisfactory soils not maintained within 3 percent of optimum moisture content at time of compaction.
 - 1) Unsatisfactory soil that is wetted or dried to within 3 percent of optimum moisture may be used as structural fill, providing soil meets all other criteria for satisfactory soils.
 - b. Any soils containing more than 3 percent (by weight) of organics, vegetation, wood, metal, plastic or other deleterious substances.
- D. Sand: ASTM C 33; fine aggregate.
- E. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 1. Survivability: Class 2; AASHTO M 288.
 2. Grab Tensile Strength: 150 lb min.; ASTM D 4632.
 3. Puncture Strength: 75 lb min.; ASTM D 4833.
 4. Flow rate: 100 GPM/ft² min.; ASTM D 4491
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 1. Survivability: Class 2; AASHTO M 288.
 2. Grab Tensile Strength: 150 lb min.; ASTM D 4632.
 3. Puncture Strength: 75 lbf; ASTM D 4833.
 4. Apparent Opening Size: No.30 to 50 sieve; ASTM D 4751.
 5. Permittivity: 0.01 per second, minimum; ASTM D 4491.

2.3 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil

materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Hoe ram hammering; or ripping of material not classified as rock excavation is earth excavation.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.
 3. Excavation for Uncontrolled Fill Removal: Relocate geotechnical boring B-2 and excavate and remove uncontrolled fill from below the proposed improvements. Extend fill removal excavation no less than 5 feet from the building edge. Notify and work directly with geotechnical engineer to identify the vertical and lateral fill extents.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Refer to WSDOT Standard Specification Section 7-08, General Pipe Installation Requirements.
- B. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- C. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
1. Clearance: 12 inches (300 mm) each side of pipe or conduit.
- D. Trench Bottoms: Excavate trenches 6 inches (150 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
- 3.8 SUBGRADE INSPECTION
- A. Notify Testing Agency when excavations have reached required subgrade.
- B. If Architect or Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Subgrade shall exhibit the following characteristics to be acceptable:
1. Subgrade shall be undisturbed native soil exhibiting a pocket penetrometer value of at least 2 tons per square foot (tsf), or;
 2. Subgrade shall exhibit structural backfill characteristics, or;
 3. Bedrock subgrades shall be near, undisturbed, flat surfaces free from protrusions above grade.
 4. Subgrade shall be protected by contractor from water intrusion, freezing, construction traffic of other detrimental conditions until final construction completed.
- D. Where the above subgrades are not identified by the Architect or geotechnical Engineer, moisture condition and compact subgrade below the building slabs, footings, and pavements with appropriate equipment. Do not compact wet or saturated subgrades.
1. Completely compact subgrade. Limit compaction equipment speed to 3 mph (5 km/h).
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect or Geotechnical Engineer, and replace with compacted backfill or fill as directed.
- E. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work only after reasonable efforts have been made to facilitate compaction via appropriate moisture conditioning and compaction equipment as determined by the Geotechnical Engineer and Architect.
- F. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Geotechnical Engineer and Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by the Geotechnical Engineer and Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by the Geotechnical Engineer and Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
 - 8. Obtaining subgrade inspection by Geotechnical Engineer.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Refer to WSDOT Standard Specification Section 7-08, General Pipe Installation Requirements.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- D. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.
- E. Backfill voids with satisfactory soil while removing shoring and bracing.

- F. Place and compact initial backfill to a height of 12 inches (300 mm) over the pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the pipe or conduit. Coordinate backfilling with utilities testing.
- H. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- J. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 3 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

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- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 6 inches (150 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact:
 - a. 92 percent from top of pipe bedding to a point 4 feet below subgrade.
 - b. 95 percent from a point 4 feet below subgrade to the subgrade level.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
 - 2. Walks: Plus or minus 1 inch (25 mm).
 - 3. Pavements: Plus or minus 1/2 inch (13 mm).
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspection agency to perform the following special inspections:
 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 2. Determine that fill material and maximum lift thickness comply with requirements.
 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: Geotechnical Engineer to review and approve footing subgrade in accordance with Geotechnical Report dated April 7, 2010 and subgrade requirements. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect or geotechnical engineer.
- E. The Owner's testing agency will test compaction of soils in place according to ASTM D 1557, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length, but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

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- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by the Owner and Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition. Except for the payment section.
- C. Any inconsistency in this section shall be resolved by application of the WSDOT Standard Specifications, most recent edition except for payment.
- D. Contractor shall conform to the recommendations outlined in the geotechnical report prepared by Grant County dated April 7, 2010. If the geotechnical report conflicts with these specifications contractor shall adhere to the more stringent.

1.2 SUMMARY

- A. Section Includes:
 - 1. Hot-mix asphalt patching.
 - 2. Hot-mix asphalt paving.
 - 3. Pavement-marking paint.
- B. Related Sections:
 - 1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
 - 2. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
 - 2. Job-Mix Designs: For each job mix proposed for the Work.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: All hot mix asphalt work shall be in accordance with the requirements outlined in the WSDOT Standards, most recent edition.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the WSDOT Standard Specifications for asphalt paving work.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
 - 2. Methods and procedures related to hot-mix asphalt paving shall comply with the WSDOT Standard Specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials or 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations and comply with the WSDOT Standard Specifications.

- B. Coarse Aggregate: Per the WSDOT Standard Specifications Section 9-03.8.
- C. Fine Aggregate: Per the WSDOT Standard Specifications Section 9-03.8.
- D. Mineral Filler: Per WSDOT Standard Specifications 9-03.8(5).

2.2 ASPHALT MATERIALS

- A. General: Use materials and gradations that have performed satisfactorily in previous installations and comply with the WSDOT Standard Specifications 5-04.2.
- B. Asphalt Binder: Per WSDOT Standard Specifications 9-02.1(4), AASHTO MP 1, PG 64-28.
- C. Asphalt Cement: ASTM D 3381 for viscosity-graded material or ASTM D 946 for penetration-graded material.
- D. Tack Coat: Per WSDOT Standard Specification 5-04.3(5)A.
 - 1. ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- E. Fog Seal: Per WSDOT Standard Specification 5-02.3(3).
 - 1. ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- F. Water: Per WSDOT Standard Specification 9-25.1.

2.3 AUXILIARY MATERIALS

- A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.
- B. Sand: Per WSDOT Standard Specification 9-03.8(4).
- C. Paving Geotextile: Per WSDOT Standard Specification 9-33.1. AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- D. Joint Sealant: Per WSDOT Standard Specifications 9-04.2(1).
- E. Pavement-Marking Paint: Per WSDOT Standard Specification 9-34. Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.
 - 1. Color:
 - a. Yellow: Parking lot channelization, parking lanes.
 - b. White: Accessible parking stalls, loading/unloading zones and accessible routes.
- F. Glass Beads: Per WSDOT Standard Specification 9-34.4, AASHTO M 247, Type 1.

DIVISION 32 – EXTERIOR IMPROVEMENTS

G. Wheel Stops: Precast, air-entrained concrete, 2800-psi minimum compressive strength, [4-1/2 inches (115 mm) high by 9 inches (225 mm) wide by 72 inches (1800 mm) long] Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 18-inch minimum length.

2.4 MIXES

A. Hot-Mix Asphalt: HMA Class ½-inch per WSDOT Standard Specification 5-04.3(7)A.

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).

2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting and replace with approved fill.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.

2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 2. Place hot-mix asphalt surface course in single lift.
 3. Spread mix at minimum temperature of 250 deg F (121 deg C).
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

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5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
 3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.
 5. hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

- A. General: Per WSDOT Standard Specification 5-04.3(10)
1. Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 2. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

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- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch (13 mm).
 - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch (6 mm).
 - 2. Surface Course: 1/8 inch (3 mm).
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.8 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
 - 1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

3.9 WHEEL STOPS

- A. Install wheel stops in bed of adhesive as recommended by manufacturer.

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- B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.11 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition. Except for the payment section.
- C. Any inconsistency in this section shall be resolved by application of the WSDOT Standard Specifications, most recent edition except for payment.
- D. Contractor shall conform to the recommendations outlined in the geotechnical report prepared by Grant County dated April 7, 2010. If the geotechnical report conflicts with these specifications contractor shall adhere to the more stringent.

1.2 SUMMARY

- A. Section Includes:
 - 1. Driveways.
 - 2. Walks.
- B. Related Sections:
 - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

B. Material Test Reports: For each of the following:

1. Aggregates.

1.6 QUALITY ASSURANCE

A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

D. Concrete Testing Service: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet, 650 ksi yield grade.

C. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A 82/A 82M.

I. Deformed-Steel Wire: ASTM A 496/A 496M.

J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.

K. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.

M. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

N. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

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1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- P. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- Q. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
1. Portland Cement: Per WSDOT Standard Specification 9-01.2(1). ASTM C 150, portland cement Type I.
- B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: $\frac{3}{4}$ inch nominal.
 2. Fine Aggregate: Pre WSDOT Standard Specification 9-03.1(2).
- C. Water: Per WSDOT Standard Specification 9-25.1.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Per WSDOT Standard Specification 9-25.1.

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- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
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. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
 - b. ChemMasters; Spray-Film.
 - c. Dayton Superior Corporation; Sure Film (J-74).
 - d. Edoco by Dayton Superior; BurkeFilm.
 - e. Euclid Chemical Company (The), an RPM company; Eucobar.
 - f. Kaufman Products, Inc.; VaporAid.
 - g. Lambert Corporation; LAMBCO Skin.
 - h. L&M Construction Chemicals, Inc.; E-CON.
 - i. Meadows, W. R., Inc.; EVAPRE.
 - j. Metalcrete Industries; Waterhold.
 - k. Nox-Crete Products Group; MONOFILM.
 - l. Sika Corporation, Inc.; SikaFilm.
 - m. SpecChem, LLC; Spec Film.
 - n. Symons by Dayton Superior; Finishing Aid.
 - o. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - p. Unitex; PRO-FILM.
 - q. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
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. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - d. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
 - e. Kaufman Products, Inc.; Thinfilm 420.
 - f. Lambert Corporation; AQUA KURE - CLEAR.
 - g. L&M Construction Chemicals, Inc.; L&M CURE R.
 - h. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
 - i. Nox-Crete Products Group; Resin Cure E.
 - j. SpecChem, LLC; PaveCure Rez.
 - k. Symons by Dayton Superior; Resi-Chem Clear.
 - l. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
 - m. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.
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. Anti-Hydro International, Inc.; A-H Curing Compound #2 WP WB.
- b. ChemMasters; Safe-Cure 2000.
- c. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
- d. Edoco by Dayton Superior; Resin Emulsion Cure V.O.C. (Type II).
- e. Euclid Chemical Company (The), an RPM company; Kurez VOX White Pigmented.
- f. Kaufman Products, Inc.; Thinfilm 450.
- g. Lambert Corporation; AQUA KURE - WHITE.
- h. L&M Construction Chemicals, Inc.; L&M CURE R-2.
- i. Meadows, W. R., Inc.; 1100-WHITE SERIES.
- j. SpecChem, LLC; PaveCure Rez White.
- k. Symons by Dayton Superior; Resi-Chem White.
- l. Vexcon Chemicals Inc.; Certi-Vex Enviocure White 100.

2.5 RELATED MATERIALS

- A. Joint Fillers:
 - 1. Furnish a one piece joint filler sized the full depth and width of the joint. If a multiple-pieced joint filler is approved, fasten the abutting ends following the filler manufacturer's recommendations.
 - 2. Pourable Joint Sealer: ASTM D 3405 or ASTM D 3406.
 - 3. Prefomed Joint Filler: AASHTO M 213. Furnish punched to receive the dowels shown on the Contract Documents.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (3 to 6 mm).
 - 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; Exposee.
 - b. Dayton Superior Corporation; Sure Etch (J-73).
 - c. Edoco by Dayton Superior; True Etch Surface Retarder.
 - d. Euclid Chemical Company (The), an RPM company; Surface Retarder Formula S.

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- e. Kaufman Products, Inc.; Expose.
 - f. Meadows, W. R., Inc.; TOP-STOP.
 - g. Metalcrete Industries; Surfard.
 - h. Nox-Crete Products Group; CRETE-NOX TA.
 - i. Scofield, L. M. Company; LITHOTEX Top Surface Retarder.
 - j. Sika Corporation, Inc.; Rugasol-S.
 - k. SpecChem, LLC; Spec Etch.
 - l. TK Products, Division of Sierra Corporation; TK-6000 Concrete Surface Retarder.
 - m. Unitex; TOP-ETCH Surface Retarder.
 - n. Vexcon Chemicals Inc.; Certi-Vex Envioset.
- F. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
- 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. Anti-Hydro International, Inc.; A-H S-Q Hardener.
 - b. ChemMasters; ConColor.
 - c. Dayton Superior Corporation; Quartz Tuff.
 - d. Euclid Chemical Company (The), an RPM company; Surfex.
 - e. Lambert Corporation; COLORHARD.
 - f. L&M Construction Chemicals, Inc.; QUARTZPLATE FF.
 - g. Metalcrete Industries; Floor Quartz.
 - h. Scofield, L. M. Company; LITHOCHROME Color Hardener.
 - i. Southern Color N.A., Inc.; Mosaics Color Hardener.
 - j. Stampcrete International, Ltd.; Color Hardener.
 - k. Symons by Dayton Superior; Hard Top.
- G. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch (9.5-mm) sieve and 85 percent retained on a No. 8 (2.36-mm) sieve.
- H. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.
- 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. Advanced Surfaces Inc.; Liquid Release.
 - b. Matcrete Precision Stamped Concrete Tools; Liquid Release Agent.
 - c. Southern Color N.A., Inc.; SCC Clear Liquid Release.
 - d. Stampcrete International Ltd.; Stampcrete Liquid Release.
 - e. Superior Decorative by Dayton Superior; Pro Liquid Release.

2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

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1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): 3000 psi (20.7 MPa).
 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 3. Slump Limit: [5 inches (125 mm), plus or minus 1 inch (25 mm)].
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content (non-colored concrete): 5.5 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.
 2. Air Content (Colored concrete): Per manufactures recommendations.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete batches of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For concrete batches larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

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1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) radius. Repeat grooving of contraction joints after applying surface finishes.
 - a. Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.
- G. Screed paving surface with a straightedge and strike off.
- H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- I. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

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1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

K. Hot-Weather Placement: Comply with ACI 305 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during

finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by using any combination of the following:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
 - 3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/2 inch (13 mm).
 - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
 - 5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
 - 6. Vertical Alignment of Dowels: 1/4 inch (6 mm).
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
 - 8. Joint Spacing: 3 inches (75 mm).
 - 9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
 - 10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

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- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least three composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 329000 - LANDSCAPE DEVELOPMENT

PART 1 - GENERAL

1.1 GENERAL

- A. Perform landscape development work as shown and specified. Comply also with Division 1 requirements.
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
- C. Landscape Contractor must be experienced in landscape work of the highest professional quality and have equipment and personnel adequate to perform the work specified.

1.2 UNDERGROUND UTILITIES

- A. Locate all underground utilities and do not disturb or damage. Promptly notify Architect of any conflict between proposed work and the obstructions. Protect said utilities and repair and/or replace any damage to same.

1.3 PROTECTION

- A. Take any necessary precautions to protect work in progress, protect adjoining property, and be responsible for protection from bodily injury due to construction operations.

1.4 WORKMANSHIP

- A. Workmanship shall be equal to the best accepted trade practices.

1.5 SCOPE OF WORK

- A. Rough Grading: It shall be the General Contractor's responsibility to do all cutting and filling necessary to provide a proper subgrade, removing from the site excess and undesirable material. Any additional fill material required will be furnished by the General Contractor from an approved source.
- B. Finish Grading: The Landscape Contractor shall be responsible for bringing planting areas to finished grade. Finish grade shall be such that the final landscape material (mulch, sod, etc.) is approximately 1/2 inch below adjacent paved surfaces after settlement. Correct all misleveled or depressed grades.
- C. Planting: The Landscape Contractor shall also be responsible for installation of all planting areas, maintenance and care of plant material, clean-up, guarantee per specifications, fertilizer, mulch, etc., in accordance with procedures outlined hereinafter.
- D. Approval, Acceptance or Substitution: Where called for approval, acceptance or permission to substitute, same shall be in writing by the Architect. Plant Material Substitution: No substitution will be permitted unless written evidence is submitted to the Architect that the specified plant cannot be obtained. Submit written confirmation of non-availability along with suggestions for substitution.

1.6 WARRANTY

- A. Special Warranty: Warrant the following exterior plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.
- B. Warranty Period for Exterior Plants: One year from date of Substantial Completion.
- C. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
- D. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - 1. A limit of one replacement of each exterior plant will be required, except for losses or replacements due to failure to comply with requirements.

1.7 MAINTENANCE

- A. Trees and Shrubs: Maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray with non-toxic chemical as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.
- B. Maintenance Period: 12-months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANTING SOIL FOR TREES AND SHRUBS

- A. Planting soil for trees and shrubs shall be a mix, consisting of 2/3 topsoil and 1/3 peat humus, compost, or well rotted manure by volume. Do not use on-site soils excavated from planting holes in mixture. Dispose of such soils legally off site.

2.2 TOPSOIL

- A. It is anticipated that sufficient topsoil will be stockpiled at the site to meet project requirements. Treat stockpiled topsoil with manure or other additives as required to meet the requirements for imported topsoil listed below.
- B. Should additional topsoil be required, provide imported topsoil which is natural, fertile, friable sandy loam, loam or silty loam, with the following characteristics:
 - 1. Soil shall conform to ASTM D 5268, have a pH range of 5.5 to 7, a minimum of 6 percent organic material content; and be free of stones 1- inch or larger in any dimension and other extraneous materials harmful to plant growth. Soil shall have soluble salts of less than 1 mmhos; nitrogen levels of above 90 PPM; phosphorous levels of 50 PPM minimum. Soil shall be free of noxious seeds and capable of supporting vigorous growth.

2. Soil shall not contain more than 5% water by volume and shall have been obtained from a naturally well-drained area.
3. Topsoil shall not be obtained from bogs or marshes. Box peat and sand are unacceptable as topsoil.

2.3 PLANTING ACCESSORIES

- A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.4 FERTILIZER

- A. Commercial-grade organic complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition: 18-10-10-7 N-P-K-S
- B. Slow-Release Fertilizer: Organic granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition: 20-10-10 N-P-K. Apply at manufacturer's recommended rate.
- C. Planting Tablets: Tightly compressed 21-gram (20-10-5) chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
- D. Dryland areas shall not be fertilized.

2.5 PLANT MATERIALS

- A. General: The Contract will be based on the bidder having verified prior to bidding, that all plants of the size, species, variety and quality noted and specified can be furnished.
- B. Quality: All plants shall be nursery-grown, of normal habit of growth, healthy, vigorous, well foliated, and free of disfigurement, disease, insect eggs and larvae. Plants shall not be pruned prior to delivery. Grading of plant material shall be in accordance with the code of standards of the American Association of Nurserymen, ANZI Z60.1 American Standard for Nursery Stock.
- C. Plant Size: Plant sizes shall be at least equal to the minimum size specified in the plant schedule. Any undergrade plants shall be removed and replaced prior to provisional acceptance.
- D. Container Stock: Shall have been grown in its delivery container for not less than 6 months, but for not more than 2 years. Any rootbound material will not be accepted. Container stock shall not be handled by trunks, stems, or tops.
- E. Anti-Desiccant: "Wilt-Pruf" or an approved anti-desiccant shall be applied to all plant material planted later than June 1st and up to October 1st. Apply in accordance with manufacturer's recommendations.

2.6 SEED AND TURFGRASS SOD

- A. Grass Seed: Fresh, clean, dry, new crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: State-Certified seed of grass species, as follows:

%	Species	Grass Drill	Broadcast with harrow or packer
41%	Bluebunch	4.5	5.6
14%	Sandberg bluegrass	1.5	1.9
14%	Indian Ricegrass	1.5	1.9
9%	Bottlebursh Squirrel tail	1	1.3
14%	Thickspike Wheatgrass	1.5	1.9
9%	Great Basin Wildrye	1	1.3
		11	13.8

- 1. All seed used shall meet the following minimum standards:
- 2. Purity 98%
- 3. Germination 98%
- 4. Weed Content .02%
- 5. Seed Rate: As shown above depending on method and equipment.

2.7 MULCH

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Medium red fir bark mulch 3” minimum, 4” maximum.
- B. Gravel Mulch: Basalt stone ranging from 1” to 2” in diameter.

2.8 EDGING

- A. Edging shall be 8x6 extruded natural color concrete with fibercrete or approved equal. Score concrete at 6 ft. intervals. Provide edging to separate grass areas from shrub, ground cover, and other landscape/mulched areas.

2.9 LANDSCAPE BOULDERS

- A. Landscape quality fractured basalt boulders. 36” minimum diameter.

PART 3 - EXECUTION

3.1 PRECAUTIONS

- A. Take precautions to protect new and existing plant material. Replace all vegetation damaged by the work of this Contract, at no additional cost to the Owner, with materials of the same size or larger, of the same species and in vigorous health and under the requirements of the guarantee for the work of this Contract.

3.2 LAYOUT

- A. Prior to commencement of planting operations, all tree locations shall be staked and marked for variety. Verify locations with Owner or Architect, or with their representative.

3.3 FERTILIZER

- A. Plants: Fertilizer 6-10-8 shall be mixed thoroughly into the soil at the rate of 5 lbs. per cubic yard of planting soil mix.
- B. Lawns: Fertilizer 5-10-10 shall be spread on top of lawn areas at a rate of 20 lbs per 1,000 sq. ft. and thoroughly mixed into soil.

3.4 TURF AREA PREPARATION

- A. Limit turf area subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 2-inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Spread on-site topsoil to a depth of 6" but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if topsoil or subgrade is frozen, muddy, or excessively wet.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
- E. Moisten prepared turf areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.4 DRILL SEEDING

- A. Sow seed with grass spreader or grass seeding machine in top 1/2" of topsoil. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

- B. Do not use wet seed or seed that is moldy or otherwise damaged.

3.5 PLANTING BED ESTABLISHMENT

- A. Loosen subgrade of planting beds to a minimum depth of 12-inches except where it would damage existing plant roots. Remove stones larger than 1-inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- B. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
- C. Spread planting soil mix to a depth of 12-inches but not less than required to meet finish grades after natural settlement. Mix bottom half of planting mix thoroughly into top 4 inches of subgrade. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- D. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- E. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.6 TREE AND SHRUB EXCAVATION

- A. Pits and Trenches: Excavate circular pits with sides sloped inward. Excavate pit only deep enough to allow root flare to remain above finish grade. Do not over excavate pit. Root ball should sit on undisturbed sub base to prevent settling. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
- B. Excavate approximately three times as wide as ball diameter for ball and burlap stock. Select one option from paragraph below if applicable. Current planting practices encourage use of native subsoil or topsoil as backfill planting soil.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

3.7 TREE AND SHRUB PLANTING

- A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball flush with adjacent finish grades.
- B. Remove burlap and wire baskets from root balls completely. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
- C. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing

remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

- D. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
- E. Set container-grown stock plumb and in center of pit or trench with root flare 1-inch above adjacent finish grades.
- F. Carefully remove root ball from container without damaging root ball or plant.
- G. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- H. Organic Mulching: Apply 3-inch minimum, 4" maximum thickness of organic mulch extending 12-inches beyond edge of planting pit or trench. Do not place mulch within 3-inches of trunks or stems.

3.8 TREE AND SHRUB PRUNING

- A. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from trees or shrubs.

3.9 MULCHING

- A. Install weed-control pre-emergent before mulching according to manufacturer's written instructions.
- B. All planting beds shall receive between 3"(minimum) and 4" (maximum) depth mulch. Uncover all plants buried or partially covered by mulch.

3.10 EDGING

- A. Place on suitable prepared compacted ground, free of organic matter.

3.11 PLANTING SEASON

- A. Trees and Shrubs: Plant anytime except during freezing weather. Do not plant when temperatures are expected to exceed 90 degrees. Written permission must be granted to plant at any other time.
- B. Sod: Sod areas anytime except during freezing weather. Do not sod when ground is frozen or muddy. Do not plant when temperatures are expected to exceed 90 degrees. Written permission must be granted to plant at any other time.

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3.12 CLEAN UP

- A. Clean up during progress of work, and upon completion. Remove from site all cans, surplus subsoil, and other debris resulting from planting and grading operations. Neatly dress and finish landscaped areas. Leave project in "First-Class" quality condition.
- B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.13 DISPOSAL

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 329000

SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction, most recent edition. Except for the payment section.
- C. Any inconsistency in this section shall be resolved by application of the WSDOT Standard Specifications, most recent edition except for payment.
- D. Contractor shall conform to the recommendations outlined in the geotechnical report prepared by Grant County dated April 7, 2010. If the geotechnical report conflicts with these specifications contractor shall adhere to the more stringent.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Nonpressure transition couplings.
 - 3. Cleanouts.
 - 4. Catch basins.
 - 5. Oil/Water Separators

1.3 SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Storm Drainage Piping:

1. Pipe: ASTM D 3034, PVC gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.2 CLEANOUTS

A. Cleanouts:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

2.3 CATCH BASINS

A. Standard Precast Concrete Catch Basins per WSDOT Standard Plan B-5.20-00:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 4-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch (102-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
7. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches (1500 mm).

8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.
1. Size: 24 by 24 inches (610 by 610 mm) minimum unless otherwise indicated.
 2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.4 Oil/Water Separator

- A. 1,000 gallon capacity precast concrete oil/water separator tank.
1. Heavy duty lid and base.
 2. Riser Sections: 4-inch (102-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
 3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 4. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
 5. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
 6. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches (1500 mm).
 7. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Frames and Covers: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading.
1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves,

and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

- C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- E. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install corrugated steel piping according to ASTM A 798/A 798M.
 - 3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 30 x 30 x 18 inches deep. Set with tops 1 inch (25 mm) above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.6 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.8 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334100