PROJECT MANUAL

Summer 2018 Projects

Prepared for:
Park Hill School District
7703 NW Barry Road
Kansas City, Missouri  64153

Volume 1 of 1: Contains the following

Introductory Information, Bidding and Contracting Requirements, Division 1-General Requirements and Technical Specification Sections, and Division 2 through 28

Projects:  17088 – Park Hill High School
           17097 – Park Hill South High School

Issue Date:  February 1, 2018
DOCUMENT 000105 - CERTIFICATIONS AND SEALS-MEP

Mechanical/Electrical/Plumbing Engineer

I hereby state, pursuant to RSMo 327.411, that the Specifications intended to be authenticated by my seal are limited to Specification Sections listed below:

Division 22 Sections: 220500, 220523, 220529, 220553, 220719, 221116, 221119, 221316, 221319, 224000;
Division 23 Sections: 230500, 230529, 230553, 230593, 230713, 230719, 230900, 231123, 232300, 233113, 233300, 233713, 237413, 237433, 238126, 238135;
Division 26 Sections: 260500, 260502, 260519, 260523, 260526, 260529, 260533, 260544, 260553, 260573, 260923, 260943, 262200, 262416, 262726, 262813, 262816, 265119;
Division 28 Sections: 284621.

I hereby disclaim any responsibility for all other specifications, drawings estimates, reports or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project or survey.

肯特·麦克考, P.E., LEED® AP

Date: 02/01/2018
## PARK HILL SCHOOL DISTRICT
### Project No: 16111, 17088, 17097, 17115

**SUMMER 2018 PROJECTS**

**PROJECT NO’S 17088 & 17097**

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 Issued: February 9, 2018

You are hereby invited to Bid on the following project, the Bid being signed and sealed in an envelope. Accompanying the Bid in the envelope shall be a signed Scope of Work and/or Bid Package Number as it applies in addition to the Bid Security. The envelope shall be clearly marked, “BID – Park Hill School District- 2018 Summer Renovations, BID PACKAGE NUMBER(s) and CONTRACTOR’S NAME”, submitted prior to the time of public opening of Bids.

Project: Park Hill School District – 2018 Summer Renovations

Park Hill High School
7701 NW Barry Road
Kansas City, MO 64153

Park Hill South High School
4500 River Park Drive
Riverside, MO 64150

LEAD Innovation Studio – 5th Floor
10150 N. Ambassador Drive
Kansas City, MO 64153

Prairie Point Elementary
8101 NW Belvidere Parkway
Kansas City, MO 64152

Gerner Family Early Education Center
8100 N Congress Avenue
Kansas City, MO 64152

Owner: Board of Education - Park Hill School District
7703 N.W. Barry Road, Kansas City, Missouri 64153

Time and Place of Bid Opening:
2:00 p.m. (Local Time) March 8, 2018.
Park Hill School District - 7703 N.W. Barry Road, Kansas City, Missouri 64153

Type of Contract:
Each Bid Package is a Lump Sum Contract direct with Park Hill School District.

Pre-Bid Conference:
3:00 PM Tuesday February 21, 2018
Park Hill School District - 7703 N.W. Barry Road, Kansas City, Missouri 64153

The purpose of this Conference will be to review general project requirements, scheduling and answer Bidder's questions. Attendance is strongly encouraged.

Pre-Bid Walkthrough:
A Pre-bid walkthrough will be held immediately after the Pre-bid Conference.

Time of Completion:
Time is of the essence for this Project and Substantial Completion must be achieved in accordance with
the Construction Schedule, unless set forth otherwise in the agreement between the Owner and Contractor. Refer to Section 013200 (013216) – Construction Schedule.

**Contractors Qualifications:**
Each Contractor desiring to Bid this work must have a minimum of five (5) years continuous experience under the current company name and must have successfully completed a minimum of seven (7) comparable scale projects using specified or similar systems. The Construction Manager and Architect will review the Bidders list for each Bid Package with the Owner. The Owner has the right to take such steps as the Owner deems necessary, to determine the ability of the Contractor to perform the Work. The Contractor shall furnish to the Owner such additional information and data for this purpose as the Owner may request. Owner has the right to reject any Bid or Bidder, after an investigation or consideration of the information submitted by such Bidder. Bids will be reviewed for both cost and competitive durations as provided on the Bid Form.

**Procurement of Bidding Documents:**
Complete sets of Plans and Specifications will be distributed electronically by the Construction Manager, Universal Construction Company, Inc. All Bidders must receive prior approval from the Construction Manager for plan release authorization. Hard copies of Plans and specifications may be obtained at Bidders own expense through Bidders own means. Bidder assumes all responsibility for verifying that they have a Complete Set of Plans obtained through their own means.

**Bid Security:**
Contractors providing labor and materials with Bids of $25,000.00 or greater are to submit Bids accompanied by a Bid Bond, or Cashier’s Check in the amount of five percent (5%) of the total Bid submitted, and made payable, without condition, to the Owner: "Park Hill School District". Suppliers are not required to furnish a Bid Security. The Bid Security must accompany each bid required as a guarantee that the bidder will enter into a contract with the Owner for the work described in the proposal and will furnish performance and payment bonds as specified.

Bids shall be made upon the Proposal Form provided in the Project Manual. The signature shall be in longhand and the completed form shall be without interlineations, alterations or erasures. All spaces in the Proposal Form are to be filled in, including acknowledgment of any Addenda received by the Bidder, Base Bid and Unit Prices.

All Bids will be publicly opened and read aloud. Bids received after said time will be returned to the Bidder unopened. Bids shall not contain any recapitulation of the work to be done. No oral, telegraphic or telephonic proposals or modifications will be considered.

No Bidder may withdraw his Bid for a period of sixty (60) days after the time of actual Opening of Bids. All securities, as applicable, will be retained in escrow by the Construction Manager until an Agreement is signed and a satisfactory Performance Bond and Payment Bond as applicable are received by the Owner.

Should a Bidder find any discrepancies in, or omissions from, any of the documents or be in doubt as to their meaning, he shall advise the Architect, who will issue the necessary clarifications to all prospective Bidders by means of Addenda.

**Bid Package - Scopes of Work are included electronically in this Project Manual in Document 002400.**

Successful Contractors providing labor and materials whose contracts are for $25,000.00 or greater shall furnish to the Owner a Bond in the Amount of 100 percent of the Contract Sum on the standard form of the American Institute of Architects, Performance and Payment Bond, AIA Document A312, as modified by the Owner, with such Sureties as may be approved. Suppliers are not required to furnish Performance and Payment Bonds.
The Contract Form will be the Standard Form of Agreement between Owner and Contractor (Stipulated Sum), AIA Document A232 - 2009 Edition, as modified by the Owner. Copies of the Contract are available for review at the office of the Construction Manager. Refer to Document 005200.

Bidders are advised that the School District is tax exempt pursuant to State of Missouri Statutes. The School District will furnish a Tax Exemption Number from the State of Missouri for the construction of this Project. A copy of the Tax Exemption letter will be furnished to each successful Contractor, who shall furnish the Tax Exemption letter to his subcontractors and material suppliers, as authorization to purchase materials for this Project on a sales Tax-Exempt basis”.

Bidders are advised that the Project is a prevailing wage project as outlined in 008100 Prevailing Wage Determination.

Schedule and Late Charges: A Construction Milestone Schedule from the Construction Manager will be included by Addendum and is for reference only. Each Bid Package is required to submit with their bid durations which will be used as criteria for awarding a contract. These durations will be incorporated into the project schedule and each Contractor will be required to meet such schedule (except for conditions beyond your control). Failure to meet such schedule will result in contractor being held responsible for delay costs incurred by the Owner, Architect, Construction Manager, and other subcontractors including but not limited to such expenses as overtime, Weekend Work, Shift Work or Extra Manpower, etc., required to bring the job back on schedule. This construction schedule is intended to be a guideline and will be revised periodically throughout the project as necessary. The schedule updates will automatically become part of the Contractor’s contract agreement.

Each Contractor shall carefully coordinate his work with the work of other trades to ensure efficient progress of the overall project. Time is of the essence in the execution of the work, therefore, sufficient men, material and equipment must be provided by each Contractor to meet the job schedule.

Contractor acknowledges that he shall meet the requirements of all sections of the Specifications, Invitation to Bid, Scope of Work, General and Supplementary Conditions and all listed documents.

Safety requirements including barricades, guardrails, etc., required by OSHA and/or other Authorities Having Jurisdiction for the protection of Contractor’s personnel and the general public shall be provided by each Contractor.

Each Contractor shall promptly notify the Construction Manager of any obstacles that would hinder the installation of their work.

The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the work. The Contract Documents are complementary, and what is required by one shall be binding as if required by all. Work not covered in the Contract Documents will not be required unless consistent therewith and is reasonably inferred there from as being necessary to produce the intended results.

**Bidders shall submit with their Bid the information:**
1. A statement of costs of the major portions of the work included in the Bid and any specific item of cost requested.
2. A designation of the Work to be performed by the Bidder with his own forces.
3. A detailed breakout showing durations of all work activities
4. Qualification Statement
5. A list of names of any Subcontractors or other persons or organizations proposed for such portions of the Work as may be designated by the Architect and Construction Manager. The Bidder will be required to establish to the satisfaction of the Owner, Architect and Construction Manager the
reliability and responsibility of the proposed Subcontractors to furnish and perform their Work. Prior to the Contract, if the Owner, Architect or Construction Manager has a reasonable and substantial objection to any person or organization on such list, and refuses in writing to accept such person or organization, the Bidder may, at his option, withdraw his Bid without forfeiture of Bid Security. If the Bidder submits an acceptable substitute with any increase in his Bid price to cover the difference in cost occasioned by such substitution, the Owner may, at his discretion, accept the increased Bid price or he may disqualify the Bidder. Subcontractors and other persons and organizations proposed by the Bidder and accepted by the Owner, Architect and Construction Manager must be used on the work for which they were proposed and accepted and shall not be changed except with the written approval of the Owner with concurrence of Architect and Construction Manager.

The Owner reserves the right to reject any and all Bids and waive any technicalities therein.

END OF DOCUMENT

001116
DOCUMENT 002100 - INSTRUCTION TO BIDDERS

Project: Park Hill School District – 2018 Summer Renovations

Owner: Park Hill School District - 7703 NW Barry Road, Kansas City, MO. 64153

Architect: Hollis and Miller Architects

Construction Manager: Universal Construction Company, Inc.

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ARTICLE 1 DEFINITIONS
1.1. Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders, the bid form, and 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 a PDF Copy of the complete sets of the Bidding Documents from the Construction Manager. Printed Copies of Bidding Documents are the Bidders Responsibility.

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

3.1.3 The Owner, Architect and Construction Manager 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 Construction Manager 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 Construction Manager 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 Construction Manager who will forward to the Architect. Such request must be received 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 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 of five percent (5%) of the bid amount. 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
5.2.1 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 Construction Manager, 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 Construction Manager 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 Construction Manager, 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 Construction Manager will notify the Bidder in writing if either the Owner, Architect, or Construction Manager after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner, Architect, or Construction Manager 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, Architect, or Construction Manager 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, Architect, and Construction Manager

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 Reference Contract Documents for requirements regarding Bidder's obligations to secure bonds.
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 A132 (CMa as Advisor), Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a Stipulated Sum.
DOCUMENT 002200 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The following Supplements apply to the above AIA Document A701, "Instructions to Bidders". The Article numbers used herein refer to the same Article numbers in that Document. Modification of these Articles, whether wholly or partially changed herein, takes precedence over any statement contained in AIA Document A701.

ARTICLE 1 - DEFINITIONS
ADD the following new Paragraph 1.10:

"1.10 The use of the word Contractor in this Document refers to the individual Contractor, Trade Contractor or Material Supplier who furnishes a Bid Proposal for labor and/or materials for the Project."

ARTICLE 2 - BIDDER'S REPRESENTATIONS
ADD the following new Subparagraph:

"2.1.5 The Bidder will not later request and will not later expect to receive additional payment for work related to conditions which can be determined by examination of the site and the Bidding Documents".

ARTICLE 3 - BIDDING DOCUMENTS
ADD the following to the end of Subparagraph 3.2.3:

"3.2.3 If a conflict in the drawings and/or specs exists and it is not clarified by addendum, the contractor shall include the cost for the more stringent in their base bid. The contractor may, at their discretion then provide a voluntary alternate as a means to clarify the discrepancy found within the documents.

ADD the following to the end of Subparagraph 3.3.1:

"3.3.1 Substitutions will be allowed only by procedures specified, refer to Section 012500. Materials, products, equipment and systems proposed by substitution are subject to approval of the Architect, his/her judgment and decision will be final. Submission of Bidder's Bid shall be taken as prima facie evidence of Bidder's compliance with these instructions."

DELETE Subparagraph 3.3.2 and SUBSTITUTE the following:

"3.3.2 Bidders proposing substitutions for materials, products, equipment or systems other than those specified in the proposed Contract Documents under the 'or equal' provisions, shall submit request for substitution in writing to the Construction Manager for initial review, recommendation and subsequent transmittal to the Architect. Submittals for proposed substitutions shall be received not later than 5:00 p.m., seven (7) calendar days prior to the date established for the Receipt of Bids. Each request shall include the name of the material, product, equipment or system for which it is to be substituted and all basic data and characteristics of the proposed item, so that a direct comparison can be readily made. It is the sole responsibility of the Proposer to submit complete descriptive and technical information necessary for the evaluation. The burden of proof of the merit of proposed substitution is upon the Proposer."

ADD Clause 3.3.2.1 as follows:

"3.3.2.1 Requests for substitution shall include the completed 'Substitution Request Form' located at the end of Section 012500. The substitution request form shall be incorporated as the first page of each submittal. Failure to submit this form will lead to disapproval of the proposed substitution."

ADD the following Subparagraph 3.3.5:

"3.3.5 Whenever substitutions alter the design or space requirements indicated on the plans, the Contractor shall include all items of cost of the revised design and construction; including costs all allied trades involved."
ARTICLE 4 - BIDDING PROCEDURES

DELETE Subparagraph 4.1.1 and SUBSTITUTE the following:

"4.1.1 Bids shall be submitted on forms identical to the form included with the Bidding Documents without modification, alteration, or reservation".

DELETE the first sentence of Subparagraph 4.2.1 and SUBSTITUTE the following:

"4.2.1 Each Contractor and Supplier with a Bid of $25,000.00 or greater shall submit Bids be accompanied by a Bid Bond written on AIA Document A310, or cashier’s check acceptable to and payable without condition to Universal Construction Co; Inc., 11200 W 79th Street, Lenexa, KS. 66214 in an amount at least equal to five (5) percent of Bidder’s Proposal, including all additive alternates. Suppliers are not required to furnish a Bid Security."

DELETE Subparagraph 4.2.2 & 4.2.3 and SUBSTITUTE the following:

"4.2.2 If the Bidder elects to provide a Bid Bond on AIA Document A312, it must also include a certified and current copy of the Power of Attorney by the Attorney in Fact who executes the Bond on behalf of the Surety”.

"4.2.3 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.”

Add Subparagraph 4.2.4

"4.2.4 The Owner/CM 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 have been furnished; b. The specified time has elapsed so that Bids may be withdrawn: or c. All Bids have been rejected.”

DELETE Subparagraph 4.3.1 and SUBSTITUTE the following:

"4.3.1 Bidders are to submit one signed original proposal accompanied by a signed Bid Package - Scope of Work and other information as described in the Invitation to Bid and/or other documents, to the Owner at the address stipulated in the Invitation To Bid in an opaque, sealed envelope, bearing the title of the Work (Bid package number(s) and title), the name of the Bidder, and shall be addressed as follows:"

Universal Construction Company, Inc.
Park Hill School District
7703 NW Barry Rd
Kansas City, MO 64153

Bids sent by mail shall be enclosed in a separate mailing envelope with a notation “Bid – Park Hill School District”, Bid Package Number(s)” and Contractor’s name on the face thereof.

NOTE: If sealed bids are mailed they should be mailed to the following:
7703 NW Barry Rd, Kansas City, MO 64153

DELETE the first sentence of Subparagraph 4.3.2 and SUBSTITUTE the following:

4.3.2 Bidders shall be responsible for actual delivery of Bid and it is not sufficient to show that it was mailed in time to be received before the scheduled closing time for receipt of Bids.”

ADD the following Subparagraphs 4.3.5 & 4.3.6:

"4.3.5 The proposal form, as shown in these Contract Documents, must be followed by each Bidder. Bid shall state the total lump sum price to do all Work described in the Bidding Documents under a single Contract. Dollar amounts shall be stated in both words and
numbers and in the case of a discrepancy between the two, the amount written in words shall govern.

"4.3.6 The Owner/CM reserves the right to waive irregularities in the Bids and reject any and all Bids."

DELETE the first sentence of Subparagraphs 4.4.1 and 4.4.2 and SUBSTITUTE the following:

"4.4.1 Any Bidder may withdraw his Bid at any time prior to the scheduled closing time for the receipt of Bids, but no Bid shall be withdrawn, modified or canceled for a period of sixty (60) days following the time and date finally designated for the receipt of Bids.

"4.4.2 Only written requests for modifications or corrections of previously submitted proposals, which are addressed in the same manner as the original submitted proposals and received by the Owner prior to the scheduled closing time for receipt of Bids, will be accepted and proposals will be corrected in accordance with such written requests provided that: Any such written request is contained in a sealed envelope which is plainly marked and must plainly state "Modification of Bid on (Project Title, Bid Package Number(s) and Bid Date)" and be sent to the following address or mailing address:

Hand Delivered and Mailing Address:
Universal Construction Company, Inc.
Park Hill School District
7703 NW Barry Rd
Kansas City, MO 64153

ARTICLE 5 - CONSIDERATION OF BIDS
DELETE Subparagraph 5.1.1 and SUBSTITUTE the following:

"5.1.1 Properly identified Bids received on time will be opened publicly and read aloud."

DELETE Subparagraph 5.2.1 and SUBSTITUTE the following:

"5.2.1 The Owner/CM reserves the right to reject any and/or all Bids and further to waive all informalities in Bidding when deemed in the best interests of the Owner."

Modify Subparagraph 5.3.1 as follows:

5.3.1 DELETE the first sentence from this Subparagraph. ADD Subparagraphs 5.3.3, 5.3.4, 5.3.5 and 5.3.6 as follows:

5.3.3 In awarding the Contract, the Owner/CM may take into consideration the Contractor's skill, facilities, capacity, experience, responsibility, previous work record, financial standing, and, in the necessity of prompt efficient completion of the Work herein described. Inability of any Contractor to meet the requirements mentioned above may be cause for rejection of this proposal. The Owner reserves the right to let other Contracts in connection with the Work at the Project Site.

5.3.4 The Construction Manager, together with the Architect, may interview the apparent low Bidders before Contracts are awarded. The interview will enable the Construction Manager and/or Architect to ask the Contractor questions about materials, labor, duration, scope of the work, or any other information necessary to evaluate those considerations enumerated in Paragraph 5.3.3 above.

5.3.5 The Owner/CM shall have the right to accept alternates in any order or combination unless otherwise specifically provided for in the Bidding Documents, and to determine the low Bidder on the basis of sum of the Base Bid and the Alternates accepted.
5.3.6 Bidder to whom award of Contract is made shall execute an agreement with the Owner/CM within seven (7) days after written receipt of Contract. Contractor’s mobilization or commencement of his Work, without having a signed Contract, will be construed as his acceptance of the Conditions and Terms of his Contract with the Owner.

ARTICLE 6 - POST-BID INFORMATION

ADD Subparagraph 6.1.1 as follows:

6.1.1 Bidders shall also submit to with their bid form as requested on the Invitation to Bid, evidence satisfactory to the Owner/CM that the Bidder and his/her proposed subcontractors have sufficient means and experience in the types of work called for in the Proposed Contract Documents to assure completion of the Contract in a satisfactory manner.

MODIFY Subparagraph 6.3.1 as follows:

6.3.1 DELETE, in the first line, the phrase “as soon as possible” and in lieu thereof, INSERT "within seven (7) days".

ARTICLE 7 - PERFORMANCE BOND AND PAYMENT BOND

DELETE Article Seven in its entirety, in lieu thereof, INSERT the following:

7.1 BOND REQUIREMENTS

7.1.1 Performance and Payment Bonds will be required from successful Bidders furnishing labor and materials whose Contract amounts are $25,000.00 or greater. Bonds may be secured through the Bidder’s usual sources. Suppliers are not required to furnish Performance and Payment Bonds.

7.1.2 Cost of furnishing such Bonds shall be included in the Bid.

7.1.3 Bonds (Bid, Payment, Performance & Public Works) must be written by a Surety Company that is listed in the latest edition of the Federal Register as holding a certificate of authority and an underwriting limit large enough for the Project. The Surety must also be licensed to do business in the State of Missouri. Two copies of all bonds shall be delivered no later than the date of execution of the Contract. If 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. Failure of the Contractor to provide and deliver the required Bonds to the Owner upon the date of execution of the Contract shall be grounds for setting aside its order awarding the Contract and if the award is set aside, the Bid security may be forfeited and retained by the Owner as liquidated damages.

7.1.4 Unless otherwise provided, the Bonds shall be written on AIA Document A312, Performance Bond and Payment Bond, as amended and modified. Both Bonds shall be written in the full amount of the Contract Sum.

7.1.5 The Bonds shall be dated on or after the date of the Contract.

ARTICLE 8 - FORM OF AGREEMENT

DELETE Article 8 in its entirety, in lieu thereof, INSERT the following:

"8.1 The Agreement for the Work will be written on AIA 132-2009. Within seven (7) calendar days of receipt of Contract, Bidder must return to the Construction Manager the Contract properly executed. Failure to execute and return the Agreement within the time stated will result in forfeiture of the Bidder’s Bid Security as liquidated damages."
ADD New Article 9 as follows:

ARTICLE 9- MISCELLANEOUS PROVISIONS

9.1 MISCELLANEOUS PROVISIONS

9.1.1 The Bidder may be requested to submit AIA Document A305 Construction Qualification Statement.

9.1.1.1 Upon receipt of your project agreement, the trade contractor shall submit the following start up documents within 30 days.

- Sign project agreement
- Certificate of Insurance
- Performance & Payment Bond (If Required)
- Safety Program
- Schedule of Values
- Initial sub/supplier list
- Project information sheet
- E-Verify form
- E-Verify Addendum
- Employee Background check affidavit
- Drug Testing Affidavit
- W-9
- OSHA 10 Affidavit
- PW-2 (If Prevailing Wage Project)

9.1.2 The Owner desires to avoid payment of sales tax on supplies, material and equipment incorporated in this project. Accordingly, all Bids shall be made without sales and use tax. The School District will provide each Contractor with the sales tax exemption number for this Project.

9.1.3 Upon completion of the Project, each Contractor will be required to complete the following forms as listed below:

- Asbestos-free Letter
- Consent of Surety (If Bond Required)
- As-builts (both hard copy and electronic copy)
- Contractors Affidavit – AIA 9706
- Final Contractors sub / supplier list
- Certificate of Substantial Completion (forms furnished to Contractor at Substantial Completion)
- Written warranty/guaranty
- Operation and Maintenance Manuals
- Final Lien Waiver – AIA 9706A
- PW-4 (If Prevailing Wage Project)
- Final AIA G 732 – Requesting Retainage

All closeout documents must be submitted to the Construction Manager within thirty (30) days of established Substantial Completion date.

(Failure to return this paperwork within 30 days can result in a $100/day back charge to the trade contractor’s contract)

9.1.4 The Bidder is hereby notified that the Immigration Reform and Control Act makes it illegal for an employer to hire, recruit, or refer for a fee someone not authorized to work in the United States. The Bidder is further notified that the Joplin School District wishes to inform the Bidder that our District likewise has a policy against hiring any person who is not authorized to work in the United States. Park Hill School District will not and does not knowingly employ unauthorized workers.
9.1.5 Before submitting a bid, each bidder shall examine and read the drawings, specifications, addenda, and all other proposed Contract Documents carefully. The bidder shall visit the site of the work. Each bidder shall fully inform himself prior to bidding as to existing conditions and limitations under which the work is to be performed, and shall include in his bid a sum to cover the cost of items necessary to perform the work as set forth in the proposed Contract Documents. No allowance will be made to a bidder because of lack of such examination or knowledge. The submission of a bid will be considered as conclusive evidence that the bidder has made such examination.

9.1.6 If a Contractor fails to maintain the project schedule due to any reason other than project changes that effect time and/or weather delays, that contractor will be responsible for delay costs incurred by the Owner, Architect, Construction Manager, and other subcontractors including but not limited to such expenses as overtime, Weekend Work, Shift Work or Extra Manpower, etc., for said delays.

9.1.7 Materials and equipment incorporated into the project are exempt from payment of State Sales Tax and such sales tax shall be excluded from bid.

A. The Owner will furnish the Contractor a proper tax exemption certificate number.

B. The Contractor shall furnish exemption certificate numbers to all suppliers from whom purchases are made and require the supplier to execute purchase invoices bearing the certificate number.

C. The contractor shall assume full responsibility for his proper use of the exemption certificate number and shall pay all costs of any legally accessed penalties for his improper use of the same.
Bids March 8, 2018

- BP-042 – Masonry
- BP-051 – Structural Steel
- BP-061 – General Trades
- BP-088 – Glass and Glazing
- BP-092 – Metal Studs and Drywall
- BP-093 – Ceramic Tile
- BP-096 – Floor Covering
- BP-097 – Resinous Flooring
- BP-099 – Painting
- BP-102 – Operable Panel Partitions
- BP-114 – Food Service Equipment
- BP-210 – Fire Suppression
- BP-220 – Plumbing
- BP-230 – HVAC
- BP-260 – Electrical
- BP-270 – Communications

Provide all labor and materials, tools, equipment, supervision and other items necessary to furnish and install the Bid Package scope of work assigned, as required per the contract documents, bidding documents, this Scope of Work and other items as issued by Addenda. The Bid Package Contract specifically includes, but is not limited to, the following.

All Bid Packages – General Scope for all Trades

A. Division 0 and 1 - General Conditions, General Requirements and Special Provisions – Complete, as required by the work of this Contract, including but not limited to the following:

1. Notice to Proceed is anticipated to be issued prior to April 1, 2018. Contractors should be prepared to start work on shop drawings, etc. as required by each Contractor’s scope of work immediately upon notice to proceed and in accordance with the construction schedule established by the CM.

2. Include Performance Bond, Labor and Material Payment Bond for base bids $25,000.00 or greater as indicated in the specifications.

3. Certified payrolls to be submitted as specified with applications for payment. Prevailing Wage is required for this project.

4. This is a CM agency project so Bid Packages will be prime contracts to the Owner as identified in the specifications. As such all trades will be responsible for all General Requirements including but not limited to those listed in these scopes, and all those listed in the front end of the documents, drawings, and specifications.

5. Each Contractor is responsible for obtain permits as related to their work with AHJ’s. Owner will obtain Building Permit.

6. Each contractor will be responsible for coordinating City and Special Inspections as required for the installation of their work with Universal and the Special Inspector/City Inspectors in this order.

7. Contractors shall perform field measurements, etc. in sufficient time to ensure delivery of their materials per the construction schedule.
   a. If contractor fails to field measure immediately upon availability, then such contractor will be responsible for delays caused by such failure.
   b. If lead time of materials and the availability of when work could be field verified is such that create concerns that Contractor would be able to meet the schedule, then Contractor shall notify Construction Manager, and through coordination between other trades, Owner,
Architect and CM may come to terms of dimensions ahead of field verifications. If Contractor doesn’t notify CM of such concerns then Contractor bears sole responsibility for delays.

8. It is each contractor’s responsibility to notify the Construction Manager of Long Lead Time Materials with their bid so that they can be properly incorporated in the construction schedule.

9. Each Contractor shall include all layout, surveying, etc. required to complete the installation of their work. This includes verifying existing construction that contractor is to build off of prior to installing their work.

10. Each Contractor is responsible for reviewing the existing conditions which includes work installed by others prior to the start of their work and notify the Construction Manager in writing immediately of any issues, etc. with the substrate that would prevent the installation of Contractor’s work. Issues include but are not limited to layout, incorrect substrate material, etc.
   a. When Contractor starts work they are accepting the substrate and acknowledging the work that they are building upon is correct. If Contractor fails to notify Construction Manager and rework is required then Contractor is responsible for their rework.

11. Each Contractor is responsible for Cleanup of debris, materials, etc that result from construction operations of their work. This Contractor will be required to clean up their debris from their work at the end of each day and upon immediate notice from the Construction Manager.

12. Unless specifically noted otherwise within a bid scope. The OWNER will provide portable toilets and dumpsters for Contractor usage. Owner provided dumpsters should not be used for Masonry, Concrete, Asphalt, Roofing, Steel, and Soils/Earthwork Debris. Such items are to be removed from site by Contractor creating such debris.

13. Receiving, handling and storage for any and all materials, equipment, and/or other misc. items pertaining to contractor’s scope of work is the responsibility of each package.
   a. Construction Manager is not responsible for any loading or unloading.

14. There will be minimal onsite storage space, as such contractors should carefully plan their work so that materials are brought to the site and installed immediately.
   a. Contractors will not be allowed to store materials inside the building footprint without prior approval from the Construction Manager.
   b. The use of storage containers, job trailers, etc. onsite will only be allowed by the approval of the construction manager.
   c. Contractors are required to provide offsite storage of materials as necessary to complete the installation of their work and in order to meet the project schedule.

15. Contractors are required to carefully plan and coordinate in advance their work with other trades in order to meet the project schedule.
   a. This includes but is not limited to where Contractor’s work is required to penetrate or be embedded in other trade’s work. Including but not limited to such items as MEPFT penetrations, Fire Extinguisher Cabinets, Embedded Anchors, Steel Penetrations, Misc Sleeves, etc.

16. Each Contractor acknowledges and agrees to terms of the Mandatory Meetings, Submittal Procedures, Cleaning, and all other Division 1 items as described in their corresponding specification sections.

17. Below is a brief list of meetings required for each Contractor, it is not an exclusive list as there will be additional meetings required.
   a. Preconstruction meeting at the start of the project.
   b. Pre-installation meetings 1 month prior to the start of major components of work.
   c. Weekly Scheduling and Planning meetings.
   d. Daily Onsite Lead Personal Walk and Talk Meetings (approximately 30 meetings at the end of each day).
   e. Construction Manager may elect to hold all site personal meetings to discuss issues that may arise during the course of the project. These are not anticipated to be more than 15 minutes and wouldn’t be held more than on a weekly basis. All personal currently working on the jobsite would be required to attend.
   f. Any other meetings deemed necessary by the Construction Manager.
   g. There will be a fine of $200 for each meeting missed, if your onsite lead and/or project manager cannot attend these meetings then company representative shall attend who is familiar with the project.
h. In addition to the above meetings, Contractor should be holding their own meetings for their field personal.

18. Each Contractor is responsible to visit site prior to bidding this scope of work to verify actual conditions.

19. Each Contractor is responsible for providing the most stringent should any discrepancies occur between the bid documents, and/or specifications that were not clarified by this bid scope or through RFI prior to bid.
   a. Each Contractor is to perform their own take off, to verify quantities. Contractor will be responsible for providing the most stringent (costly) should any discrepancies occur between the quantities listed on drawings/specifications and actual quantities that could be taken off.

20. Each Contractor is responsible for Safety as it pertains to their work and as required by authorities having jurisdiction, including safety of all persons and property during performance of their work. Each Contractor will be required to submit a Project Specific Safety Plan as it relates to their work to the Construction Manager. Reference the front end documents for requirements of this plan.
   a. Each Contractor will be responsible for ensuring safe working conditions for all other personnel inside the building as it relates to exposed or open conditions, scrubbers required for indoor equipment, and proper ventilation, etc. complete as needed.

21. Each Contractor must provide all means for completing their work per the Construction Schedule.
   a. Extended work hours or weekend work shall be included as required to meet the durations provided on the Bid Form to allow the succeeding Contractor to complete their scope of work within their allotted time frame.
   b. Durations provided on the bid form shall be established to allow each Contractor to complete work to meet the dates outlined in the milestone schedule. The milestone schedule is provided for reference to identify general time of year work is to take place and the Project Schedule will incorporate the durations provided by the awarded contractors.

22. Multiple crews and mobilizations will be required for the completion of each contractors work.

23. Items listed throughout each bid package apply to the entire scope of work for that package and do not pertain specifically to the section they may be listed under.

24. Each Contractor is responsible for Coordination with the Construction Manager and other trades as required for the completion of the project.

25. It is each contractor’s responsibility to review other trades bid packages for coordination and scope identification, none of which relieve this contractor of responsibilities identified in this package.

26. All Bonds and costs for such, as it relates to this package are to be provided by this package. This includes bonds required by the Contract Documents, City, State, and any other Governing Agencies having jurisdiction.

27. Each Contractor is responsible for reviewing the entire Contract Documents, including but not limited to all specifications, drawings, addendum, Pre-bid Meeting Minutes, etc, for work required to be completed by the bid scope.

28. The term as required used throughout each scope of work, means as drawn, specified and/or reasonable inferred by the documents.

29. The Term Provide means all labor, materials, equipment, tools, delivery, etc. necessary for a complete installation.

30. Where work is required of this package inside the existing building it will be the responsibility of this package to properly cover and protect existing finishes to prevent damage. This includes all floors, walls, furniture, ceilings, doors, fixtures, and all other finishes both in the area of work and to and from such areas inside and outside the building.

31. Contractors will be responsible for their own procurement of complete hard sets of construction documents for field and office use.

32. If/where notes in drawings refer to the General Contractor this should be understood to be a trade contractor as identified by the scope of works provided in this section of the specification.

33. As required by the State of Missouri the following statements will be made part of the contract.
   a. Not less than the prevailing hourly rate of wages, as set out in the wage order attached to and made part of the specification for work under the contract, shall be paid to all workers performing work under the contract. (Section 290.250. RSMo).
b. The contractor will forfeit a penalty to the contracting public body of $100 per day (or portion of a day) for each worker that is paid less than the prevailing rate for any work done under the contract by the contractor or by any subcontractor. (Section 290.250. RSMo). For detailed information on rules and occupational titles, see 8 CSR 30-3.010 through 3.060.

c. The contractor and all subcontractors to the contract must require all on-site employees to complete the ten-hour construction safety training program required under Section 292,675. RSMo, unless they have previously completed the program and have documentation of having done so.

i. The contractor will forfeit a penalty to the contracting public body of $2500 plus an additional $100 for each employee employed by the contractor or subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training. (Section 292,675. RSMo).

d. Contractor is required to report to the Construction Manager and Owner if any bid subsidies where used within 10 calendar days after award of contract.

e. Contractor is required to complete Missouri form PW-2 Prevailing Wage Project Notification Form and list all subs who will be used on the project with the form. This form is required to be submitted to the State of Missouri and provide a copy of the form to the Construction Manager with evidence that the form was submitted to the State of Missouri.

34. Provide Back Ground Checks of all onsite personal as outlined in the front end of the contract documents.
BID PACKAGE 042 – Masonry

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Masonry as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Demolition / Existing Conditions
    – Complete as related to the work of this contract.
    1. Section 024119 – Selective Demolition
       – Complete, including, but not limited to the items listed throughout this bid package.
       a. Any sawcut / removal of existing block, brick, or stone indicated on the drawings is by this package.
       b. Salvage brick to be used for reinstallation.

III. Division 04 – Masonry
    – Complete as related to the work of this contract.
    1. Section 042000 – Masonry
       – Complete including, but not limited to the items listed throughout this bid package.
       a. Provide for Masonry Infill of Walls/Openings, etc. as drawn or specified. Including all reinforcing, grouting, etc. necessary for a complete installation.
       b. Clean and Dress all Masonry ready for paint.
       c. Provide all fall protection, temporary bracing and Safety Protection required by agencies having jurisdiction in order to complete this packages work. Removal of protection must be coordinated with the Construction Manager. Provide and install temporary covers in openings created by this Contract as required.
       d. Include soaping in as required.
       e. Include toothing new CMU block as required.
       f. Grout door frames as required.
       g. Include bull nosed edges, half bullnose, bond beams, and special shaped block as required
       h. Provide and install all horizontal and vertical reinforcement and accessories as required for masonry.
       i. Include all patch back of masonry walls indicated on Demo/Architectural Plans as required. This includes locations where existing walls, ceilings or frames have been removed to expose unfinished masonry work. This contractor is responsible for field verification of existing walls that abut materials to demo to confirm potential of work required.
       j. If masonry patchback is required to install new MEP work, but is not indicated on Architectural Drawings than such will be provided by the MEP trade requiring the work.
       k. Steel lintels for masonry shall be furnished by BP-50 and installed by this contractor as drawn and/or specified.

IV. Division 07 – Moisture Control and Insulation
    – Complete as related to the work of this contract.
    1. Section 079200 – Sealants
       – Complete including, but not limited to the items listed throughout this bid package.
       a. Provide all Fire and/or sound caulking and associated materials at any masonry walls where the masonry abuts the ceiling or adjacent walls at rated assemblies. Sealing penetrations at these walls will be by the trade making the penetration.

V. Other Bid Requirements
   1. Alternates
2. **Unit Prices**
   a. (not used)

3. **Allowances**
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

4. **Durations** – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. Material Delivery from approved submittals
   c. Masonry Demo
   d. Masonry Install

**VI. Exclusions**
   a. (not used)

<End of Bid Package 042>
BID PACKAGE 051 – STRUCTURAL STEEL

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Structural Steel as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 05 – Metals – Complete as related to the work of this contract.
   1. Section 051200 Structural Steel – Complete in its entirety, including but not limited to the following:
      a. This Contractor shall furnish and install all structural steel beams, lintels, columns, bearing plates, steel plates, girders, struts, bolts, anchors, welds, bridging, curb angles, floor opening framing, shelf angles, metal ladders, railings, seismic restraint angle for CMU walls and all other miscellaneous steel work as required by the plans and detail drawings.
      b. In Masonry walls; anchor bolts, bearing plates, and loose steel lintels will be provided by this package, but installed by the Masonry Contractor. This package is required to coordinate as required for the installation of this work.
      c. Anchor bolts and other imbeds for structural steel columns, etc. in concrete footings are to be provided by this package but installed by the General Trades Contractor. This package is required to coordinate as required for the installation of this work.
      d. Fabrication shall be in accordance with the drawings. All member shall be punched or drilled where required for the attachment of other materials. Provide templates for the setting on cast-in-place anchor bolts for columns and other structural member. All connections not specifically detailed on drawings shall be designed by steel fabricator.
      e. Provide all miscellaneous metal angles, frames, clips, bolts, screws, anchors, sleeves, lintels, and all other items required to properly install all the steel work described in the drawings. Provide all miscellaneous accessories, including but not limited to; anchor bolts, angles, clips, rails, brackets, guard posts, and other items as shown in the drawings or as may be reasonably incidental to other work described.
      f. Contractor shall furnish all erecting tools, derricks, engines, bolts, scaffolds, supports, braces, and all other items needed for the complete erection of the steel work.
      g. This Contractor will provide all steel supports for other items/equipment such as supports and braces for Operable Panel Tracks and Partitions, swing supports, all-thread, etc. Coordinate with BP-102 (i.e. N9/S301 -PHHS).
      h. This Contractor will provide all structural steel supports and braces for Glass Barn Doors. Coordinate with BP-088.
      i. This Contractor will provide and install all channels, angles, steel plates, anchor rods, that are required for installation of new stud/gypsum walls.
      j. All field connections shall be bolts and/or welded, unless specifically noted. All bolted connections shall be with high strength bearing type bolts and hardened washers unless noted otherwise. Bolts shall be set by “the-turn-of-the-nut-method” to the proper torque.
      k. This Contractor is responsible for all layouts associated with the installation of their work from existing control joints.
      l. Provide and install all miscellaneous steel supports.
      m. Provide and install all Unistrut systems as required for ceiling systems provided by BP-092.
      n. Grouting of column base plates and grouting of beam bearing plates is by this package.
      o. Provide factory galvanization of steel where required.
      p. Provide steel deck and angle additions and modifications as required for new MEP work at the roof. Coordinate exact requirements with the respected MEP trades. Patch back of the
roof for weather tightness shall be by others.

2. **Section 052100 Steel Joist Framing** – Complete in its entirety, including but not limited to the following:
   a. This Contractor will provide all joists, braces, metal angles, frames, clips, bolts, screws, anchors, rods, all other items required to properly install operable partitions, described in the drawings.
   b. This Contractor will provide all steel supports that support and brace operable panel tracks and partitions.

III. Other Bid Requirements

1. Alternates
   Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.
   a. Alternate 4 – BP-051 to provide credit if all Unistrut Systems is provided by BP-092 in lieu of BP-051 for the ceiling systems as shown.

2. Unit Prices
   a. (not used)

3. Allowances
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

4. Durations – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. Anchor Bolt Delivery from approved submittals
   c. Loose Lintel Delivery from approved submittals
   d. Structural Steel Install
   e. Unistrut Install (Alternate #4)

IV. Exclusions
   a. (not used)

<End of Bid Package 051>
BID PACKAGE 061 – GENERAL TRADES

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the General Trades as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Demolition – Complete as related to the work of this contract.
    1. Section 024119 – Selective Demolition – Complete, including, but not limited to the items listed throughout this bid package.
        a. Provide all labor, equipment, materials, etc. necessary to complete the Demo work required by this contract including but not limited to the following:
        b. Contractor should visit site prior to bid in order to establish full scope of work. No additional cost will be accepted for work that could be identified via a site visit prior to bid.
        c. This Contractor will be required to make multiple mobilizations and will be required to provide the necessary manpower for the concurrent projects.
        d. Exclude only items identified below as all other Demo is by this package
        e. Demo of Flooring and floor prep will be by Contractor installing New Flooring
        f. Demo of MEPFT Equipment/Fixtures will be cut lose and dropped to the floor by MEPFT Trades. This package will collect and dispose of MEP debris into dumpsters provided by owner.
        g. Ceiling Demo is by BP-092 Metal Studs and Drywall.
        h. Any sawcut / removal of existing block, brick, or stone indicated on the drawings is by BP-042.
        i. All other Demo is by this Package and Contractor should reference all drawings for the extent of such demo including locations where demo is needed in order to accommodate new construction.
        j. Take photos of existing conditions prior to demolition. Avoid additional demo or damage as required while performing such work. If additional damage occurs during the work of this package it will be the responsibility of this package to repair to match existing.
        k. This Contractor will remove existing metal frames, door, and all related hardware, existing casework, markerboards, lockers, closet shelves and rod, display case glazing, and shelves.
        l. Demolition where specifically identified on Architectural and Architectural Demo Plans (AD Drawings) required to accommodate MEPFT shall be done by this package. Coordinate with applicable trades to minimize over demo.
        m. If such Demo is required but not specifically identified on Architectural and Architectural Demo Plans (AD Drawings) than such work will be required by MEPFT Trades.
        n. Note that Saw cutting and removal of Concrete Slabs shown on Architectural and Architectural Demo Plans (AD Drawings) and pouring back after installation of MEPFT work is by this package.
        o. Patch back with an Emaco quick cure or comparable product that is compatible with applicable flooring systems Coordinate with Flooring Installer as required.
        p. Remove, salvage, and store as required for items indicated to be turned over to owner or required to be reused.
        q. Maintain minimal over demo to ensure proper patch back at adjacent areas is kept to bare minimum.

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III. Division 03 – Concrete – Complete as related to the work of this contract
1. **Section 033000 – Cast-in-Place-Concrete** – Complete as related to the work of this contract, scope to include footings, slabs-on-grade, trench repairs for slabs-on-grade, etc. Refer to Structural drawings for additional information.
   a. This Contractor is to include in his scope the necessary materials, labor and equipment, forms, mixing, placing, reinforcing, finishing, misc. accessories, etc. required to complete all concrete.
   b. Provide and install all connections required in concrete installed by this package.
   c. Pour back of Slabs demoed by this package is by this package include reinforcing as required.
   d. Contractor shall use EMACO (or other approved, quick curing concrete) for all concrete patch back work.
   e. When patching back slabs include using rebar in pour back every 24” OC.

IV. Division 06 – Wood, Plastics, and Composites – Complete in its entirety, including but not limited to the following:
1. **Section 061000 – Rough Carpentry** – Complete in its entirety, including but not limited to the following.
   a. This Contractor should carefully review the contract documents and specifications and shall include the all necessary materials, labor, and equipment required for the complete installation including but not limited to all wood ground nailers, all blocking, all roof blocking, miscellaneous wood framing, wood furring, plywood sheathing, fire-retardant treated plywood, etc.
   b. This Contractor will provide blocking and framing as indicated and as required to support facing materials, fixtures, specialties, installed, casework, partitions, VSDs, projection screens, and other misc. items.
   c. Exclude wood blocking at L1/A101 at LEAD Innovation Studio. All other blocking will be by this package.
2. **Section 061000 – Sheathing** – Complete in its entirety, including but not limited to the following.
   a. Provide backing for all casework, accessories, owner provided equipment, to support MEPFT wall mounted equipment, misc. items, etc.
   b. Provide suitable wall backing as shown on the Kitchen/Serving Plans and as required by the owner shall be provided by this Contractor.
   c. Cementitious Wall Sheathing – Provide and install all cementitious tile backer board/cementitious wall sheathing where wall tile is drawn and/or specified. (Reference Sheets A101G, A622, A623, and A624 at PH South)
   d. Provide wood cleats for countertops as required.
   e. Exclude Glass-Mat Sheathing as this is by BP-092
3. **Section 062023 – Millwork, Custom Casework** – Complete in its entirety.
   a. Provide access panels on all custom casework as required to allow installation of internal electrical wiring, conduit, and devices.
   b. Provide and install all aluminum reveals in custom casework.
4. **Section 064023 – Custom Countertops** – Complete in its entirety, including but not limited to the following.
   a. This Contractor will complete all interior finish carpentry.
   b. This Contractor will provide and install all solid surfacing window sills.
   c. Provide and install back and side splashes for all plastic laminate and solid surface tops where they abut new or existing walls regardless if splashes or shown or not.
   d. Coordinate location of any grommets in tops with owner and provide trim rings as required for a finished product.
   e. Provide and install all plywood shelving, standards, and brackets as required.
5. **Section 066400 – FRP Panels** – Complete in its entirety.
   a. Provide Marlite, or comparable product, meeting specified requirements. M6/A101G

V. Division 7 – Thermal and Moisture Protection – Complete as related to the work of this contract.
1. **Section 072100 – Thermal Insulation** – Complete as related to the work of this package.
2. **Section 079200 – Joint Sealants** – Complete as related to the work of this package.
   a. Provide Joint Sealants where required to finish installation of this package's work and where this package's work would penetrate others' work. MEPFT has Sealants for their penetrations.
   b. Caulking of metal frames, casework, etc. is by this package.

VI. Division 08 – Openings – Complete as related to the work of this contract
1. **Section 081113 – Hollow Metal Doors & Frames** – Complete in its entirety, including but not limited to the following:
2. **Section 081416 – Flush Wood Doors** – Complete in its entirety, including but not limited to the following:
   a. This package is responsible for all Wood Barn Doors. Glass Barn Doors will be by BP-102.
   b. Doors will be unfinished and field finished to match existing location by BP-099.
3. **Section 083113 – Access Door and Frames** – Complete as related to the work of this contract:
4. **Section 083323 – Overhead Coiling Door** – Complete in its entirety, including but not limited to the following:
5. **Section 087100 – Door Hardware** – Complete in its entirety, including but not limited to the following:
   a. Provide all labor, materials, equipment, misc. materials, hardware, accessories, etc. necessary for a complete installation.
   b. Provide all access doors as drawn or specified. Access Doors not drawn or specified but required by MEPFT trades will be by those trades as required.
   c. Provide all Finish Hardware for doors and frames installed by this package.
   d. Provide cylinders/cores for doors provided by BP-088. Coordinate with BP-088 to ensure door hardware accepts cylinder.
   e. Keying of all door hardware is by this Contractor. Coordinate requirements with the District.
   f. Furnish access control devices and turn over to Electrical Contractor BP-260 for installation. Provide raceways and pull strings in doors and frames for BP-260 to use
   a. Provide/Prep openings in doors and frames as required to allow installation of such devices.

VII. Division 10 – Specialties – Complete as related to the work of the contract
1. **Section 101100 – Visual Display Boards** – Complete in its entirety, including but not limited to the following:
   a. Visual display wall coverings AP1 and AP2 (i.e. A622, Park Hill South) Material Finish legend will be provided by BP-099.
   b. This package is to provide all marker board, magnetic glass write boards, write boards, tach board assemblies as drawn and/or specified.
2. **Section 101400 – Signage** – Complete in its entirety, including but not limited to the following:
   a. This package is to provide all signage as indicated or required.
   b. Wall vinyl graphics will be provided by BP-099.
   c. This package is to provide all dimensional graphics as indicated or required.
3. **Section 102600 – Wall and Door Protection** – Complete in its entirety, including but not limited to the following:
   a. Do not include corner guards in base bid. Reference alternate 5.
4. **Section 104413 Fire Extinguishers and Cabinets** – Complete in its entirety.

VIII.Division 11 Equipment – Complete as related to the work of this package.
1. **Section 115213 – Projection Screens** – Complete this section in its entirety, including but not limited to the items indicated in this scope of work.
   a. Provide all manually and electrically operated projection screens. Coordinate with electrician as required.
   b. Provide all controls, limit switches, etc. as required

IX. Division 12 – Furnishings – Complete in its entirety.
1. **Section 122413 – Roller Shades** – None in Base Bid, See Alternate 3.
2. **Section 123200 – Modular Casework and Trim** – Complete in its entirety, including but not limited to the following:
   a. Provide all misc. items in conjunction with Casework, including but not limited to, spacers,
hangers, supports, locks, etc.

b. Provide all joint sealants in conjunction with Casework. Including but not limited to caulking of all backsplashes.

c. Coordinate with other trades to ensure openings sizes, etc. are sufficient.

d. Include filler panels where required.

e. This Contractor is responsible for ensuring that end panels are flush and will provide filler pieces in Casework to accommodate such.

X. Other Bid Requirements

1. Alternates
   Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.
   a. **Alternate 2** – Alternate includes all labor, materials, equipment, and appurtenances to install Mecho Shades at the Media Center West (2) Story Curtainwall. Base Bid no Mecho Shades.
   b. **Alternate 3** – Alternate includes all labor, materials, equipment, and appurtenances to install Door G123b and new window 6 in Area “G”. Base bid will have existing doors remain and no window installed.
   c. **Alternate 5** - Provide full height, surface-mounted, stainless steel corner guards. Fabricate from one-piece, formed or extruded Type 316 stainless steel with formed edges; with 90-or 135-degree turn to match wall condition, and mounting hardware/accessories. Per Sheet Note 1 on A102.

2. Unit Prices
   a. (not used)

3. Allowances
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.
   b. Provide a force allowance of **$10,000 dollars**. Unused portions of this allowance will be returned to the owner.

4. Durations – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. **All Submittal Preparation**
   b. **Casework Material Delivery from approved submittals**
   c. **Hollow metal frame Material Delivery from approved submittals**
   d. **Doors and Hardware Material Delivery from approved submittals**
   e. **Specialties and Projection Screen Material Delivery from approved submittals**
   f. **Demo Complete**
   g. **Set HM Frames**
   h. **Set Casework and Tops**
   i. **Install all Specialties and Projection Screens**
   j. **Swing and Hardware Doors**.

XI. Exclusions
   a. (not used)

<End of Bid Package 061>
BID PACKAGE 088 – ALUMINUM STOREFRONTS AND GLAZING

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the 
Aluminum Storefronts and Glazing as required per the contract documents, specifications, drawings, 
bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically 
includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the 
   Contract.
   1. Provide all work as it relates to this contractor's scope of work per the “General Scope for all 
      Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this 
      scope.

II. Division 7 – Moisture Control and Insulation - Complete as related to the work of this contract.
   1. Section 079200 – Joint Sealants – Complete as related to the work of this package.
      a. Provide all joint sealants and backer rods necessary for a complete installation for all 
         aluminum entrance doors and storefront framing systems, and all glass and glazing film.
      b. Include caulking of glass to glass or glass and aluminum framing at the perimeter of your 
         assemblies as specified or shown on the drawings.

III. Division 8 – Doors, Windows, Glass, Hardware - Complete as related to the work of this 
     contract.
   A. Section 084413 – Aluminum Entrance Doors and Storefront Framing System – Complete 
      the section in its entirety.
   B. Section 085613 – Service Windows – Complete (i.e Window type 8-PHHS)
   C. Section 088700 – Complete the section in its entirety.
      1. Provide and install complete all WT1 as noted on sheet A681 Park Hill South High School.
   D. Section 088000 – Glass and Glazing Film – Complete the section in its entirety.
      1. Provide all work required for complete installation of all Aluminum Entrances / Storefronts and 
         Glazing.
      2. Glass Barn Doors are to be provided and installed complete by this package.
      3. Provide and install all filler plates, shims, U-channels, etc. for a complete installation.
      4. Provide pathway and pull strings in doors/frames where access controls are required at this 
         contractor’s work (ex. ADA push buttons). Wiring will be by others.
      5. Provide and install complete jamb closure membrane shown on sheet A102 detail H17 on the 
         Park Hill High School Drawings. Include stuffing these closure pieces with sound batt 
         insulation.
      6. Provide and install all hardware associated with the items supplied in this work package. 
         Cores for these openings will be by BP-061 but coordinated with your hardware.
      7. Provide all glazing necessary for a complete installation; such as monolithic float glass, 
         monolithic fully tempered float glass, and fire protective glass.
      8. Provide glass for all wood doors schedule to received barrowed light kits. Light kits shall be 
         provide by BP-061.

IV. Division 10 – Specialties – Provide Complete only as it relates to the following items.
   A. Fire Rated Transaction Windows – Complete. (i.e G6/A503 – PHHS)

V. Other Bid Requirements
   1. Alternates – Reference the Alternate Section and Include Alternate Pricing on the Bid Form as 
      it relates to the Work of this Bid Scope that would be required by such alternate.
      a. Alternate #3 – Provide additional glass work as required if Alternate #3 is accepted. (See 
         Page Spec 1 – Alt #3 for details on the additional aluminum window and glass work for the 
         door required).
2. **Unit Prices**  
a. *not used*

3. **Allowance**  
a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

4. **Durations** – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.  
a. *Submittal Preparation*  
b. *Storefront Delivery from approved submittals*  
c. *Rated Glass Transaction Window Delivery from approved submittals*  
d. *Glass Delivery From Measurements*  
e. *Rated Glass From Measurements*  
f. *Storefront Install*  
g. *Glazing Install*  

VI. **Exclusions**  
1. Demo of existing aluminum store fronts and glazing  
2. Aluminum reveals at casework and drywall that is not used to seat glass systems shall be provided by others.

<End of Bid Package 088>
BID PACKAGE 092 – METAL STUDS, DRYWALL & CEILINGS

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Metal Studs, Drywall and Ceilings as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Existing Conditions – Complete as related to the work of this contract, including but not limited to the following:
   1. Section 024119 – Selective Demolition – Complete as related to the work of this contract including but not limited to the following:
      a. Demo all Ceilings including but not limited to all Acoustical, Hard Lid Ceilings, etc.
      b. Salvage any ceilings indicated to be reused for reinstallation by this package.
      c. Protect ceilings that are to remain during demo.
      d. Take Pictures of Ceilings prior to demolishing to.
         i. If this package damages any ceilings indicated to remain and cannot produce pictures taken prior to demo showing existing conditions. Then this package will be responsible for replacing with new ceiling at no cost to owner.
      e. If ceilings are required to be demoed to accommodate MEPFT overhead work but are not specifically called out for on the Architectural and/or Architectural Demo Plans (AD) then such Demo will be by MEPFT trades. All ceilings called out for on Architectural and/or Architectural Demo Plans (AD) are by this package.
      f. If Demo Plans call for ceilings to be removed but Finish Schedule/Ceiling Plans do not show new ceiling then this contractor should anticipate new ceiling being required and include such with their bid. Only reuse existing ceiling grid / tile if specifically called out to be reused.
      g. If Finish Schedule/Ceiling Plans show new ceilings to be installed, but Demo Plans do not indicate existing ceilings to be removed, then this contractor should anticipate demo of existing ceilings and include such with their bid.
         i. No Additional Cost claims will be accepted for either of the above conditions.

III. Division 05 – Metals – Complete as related to the work of this contract.
   1. Section 054000 – Cold Formed Metal Framing – Complete this section in its entirety, including but not limited to the following:
      a. Provide an install complete all cold formed metal framing as required. Includes all wall framing, ceiling framing, soffit framing, misc. framing, etc.
         i. See details A1 and A9 on sheet A521 for Park Hill South High School.

IV. Division 07 – Thermal and Moisture Protection – Complete as related to the work of this contract.
   1. Section 072100 – Thermal Insulation – Complete including, but not limited to the items listed throughout this bid package.
   2. Section 078413 – Penetration Firestopping – Complete in its entirety including but not limited to the follow.
      a. All batt insulation, fire stopping, and penetration firestopping with be provided and installed complete by this package.
      b. This will include installation at all gyp walls to deck and penetrations from structural joists.
      c. This package will provide and install complete bent enclosure plates.
   3. Section 079200 – Joint Sealants – Complete, as related to the work of this package, including but not limited to the following:
a. M.E.P. Contractors are to provide for their own penetrations.
b. Provide and install Joint Sealants and firestopping as it pertains to this scope of work where this work abuts ceilings walls or steel.
c. Provide all control joints and/or expansion joints in work installed by this package as required including all ceilings, walls, etc.

V. Division 09 – Finishes – Complete as related to the work of this contract.
1. Section 092216 – Non-Structural Metal Framing – Complete this section in its entirety, including but not limited to the following:
   a. This package is to provide and install complete all light gauge metal framing such as; stud framing, z furring, hat channels, bracing, etc. required for a complete installation.
   b. This contractor is to provide and install complete all suspension systems for all gypsum ceilings and soffits as drawn and/or specified.
   c. Provide wall layout for all work in this package, including initial wall layout in existing areas and clear lacquer spray of all lines for use by other trades.
   d. Related cleanup.
2. Section 092900 – Gypsum Board – Complete this section in its entirety, including but not limited to the following:
   a. Provide openings as necessary for mechanical and electrical panels.
   b. Provide and install all labor, materials, tools, scaffolding, etc. as required to erect all drywall, dropped ceilings/soffits.
   c. This package is to include all corner beads, control joints, taping, sanding, etc. as required for a complete installation.
   d. This package shall provide misc. patching of Gypsum Board to match existing as required in areas as noted. This includes areas specifically identified by Architectural Demo Plans (AD Sheets) to receive patch back. This includes locations where existing walls, ceilings or frames have been removed to expose unfinished drywall related work. This contractor is responsible for field verification of existing walls that abut materials to demo to confirm potential of work required.
   e. Demolition and patch back of other areas required for MEPF trades to install that is not specifically identified in drawings and/or specs will be the subsequent MEPF packages to demo and patch back as required to complete the installation of the work of their package.
   f. Restoration of existing firewalls that is found following the removal of ceilings shall be handled on a T&M basis from this contractor’s allowance.
   g. Related cleanup.
   h. Include wood blocking/framing for drywall assembly at L1/A101 – LEAD Innovation Studio. All other wood blocking shall be by BP-061.
   i. Include any control joints called out on the drawings as spec section 092000.
   j. Provide and install all aluminum reveals where installed in gypsum wallboard assemblies. All other aluminum reveals shall be provided by others.
3. Section 095113 – Acoustical Panel Ceilings – Complete this section in its entirety, including but not limited to the following:
   a. Provide openings as necessary for Mechanical and Electrical access panels.
   b. This contractor is to provide and install complete the suspension systems for all gypsum ceilings, soffits, and grid as drawn and/or specified. Tie wires for suspension of electrical and other devices shall be provided by others.
   c. Provide coordination with Electrical and HVAC work for light fixture and grille locations in lay-in ceilings grids.
   d. Include special conditions for ceilings around projection screens, VRF Units, or other equipment/obstructions as necessary to be placed in the ceilings. Ceiling materials to be modified in order to allow equipment to function properly. Coordinate with respective Contractors.
   e. This package is to provide and install any and all sound attenuations blankets as drawn and/or specified.
   f. Where drawings indicate to demo ceilings and leave support wire for later use this package should confirm and add additional wires as needed for proper support of new ceiling when
g. Any patching and repairing of gypsum ceilings that is drawn or specified is required.

h. Salvage any ceiling tile that is called out to be removed/demolished but reinstalled.

i. At the Lead Innovation studio this contractor will be required to remove ceiling grid and tile where new walls are to be built. Once new walls are built this contractor will be responsible for tying grid back into walls for a complete installation. Be sure to salvage ceiling tile for reinstallation.

j. At the LEAD Innovation studio, this contractor shall remove, protect and reinstall all ceiling tile at Rooms A100, A101, & A102. Coordinate that all above ceiling work in these rooms has been completed prior to the reinstallation of this tile.

k. At the LEAD Innovation studio, remove and reinstall flooring as needed for the installation of floor track for your new walls.

l. Related cleanup.

4. **Section 097723 – Fabric Wrapped Wall Panels** – Complete this section in its entirety, including but not limited to:
   a. Provide and install all “WP_” designated wall panels.

5. **Section 098433 – Sound Absorbing Wall Panels** – Complete this section in its entirety, including but not limited to:
   a. Provide and install all “AP1 and AP2” designated wall panels.
   b. This package should include accessories clips, facing and/or backing materials associated with specific panels, mounting devices, etc. as required for a complete installation.

6. **Section 098436 – Acoustical Ceiling Baffles** – Complete this section in its entirety, including but not limited to:
   a. Provide and install complete all acoustical ceiling baffles.
   b. This package is to include the mounting system and all accessories needed for a complete installation.

### VI. Other Bid Requirements

1. **Alternates** – Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.
   a. **Alternate #4** – Add cost for BP-092 to provide and install all Unistrut Systems in lieu of BP-51 for the ceilings systems as shown.

2. **Unit Prices**
   a. *(not used)*

3. **Allowance**
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.
   b. Provide a **$5,000 Allowance** to be used only at the Direction of the Construction Manager. Unused portions will be returned to the owner.

3. **Durations** – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. **Submittal Preparation**
   b. **Wall Panel and Ceiling Baffles delivery from approved submittals**
   c. **Stud Framing**
   d. **Hang and Finish Gypsum Walls, Soffits, Ceilings**
   e. **Ceiling Grid Install**
   f. **Unistrut System Install**
   g. **Acoustical Ceiling Baffles Install**
   h. **Wall Panel Install**

### VII. Exclusions

a. *(not used)*
BID PACKAGE 093 – CERAMIC TILE

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Ceramic Tile as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor's scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 07 – Thermal and Moisture Protection – Complete as related to the work of this contract.
   1. Section 079200 – Joint Sealants – Complete, including, but not limited to the items listed throughout this bid package.
      a. Provide and install all joint sealants as required to sell this contractor’s work.

III. Division 09 – Finishes – Complete as related to the work of this contract.
   1. Section 093000 – Ceramic Tile – Complete including, but not limited to the items listed throughout this bid package.
      a. Contractor to furnish all labor, material, equipment, etc. necessary for a complete installation for all floor and wall tile.
      b. Provide and install ceramic, porcelain, and/or stone flooring/wall materials with metal edge strips, reducer strips, and/or bull nose trim as drawn or specified.
      c. Provide Schluter metal edge strips where indicated.
      d. This scope includes waterproof membrane material and slip membrane over construction joints if needed for proper installation of scheduled materials.
      e. Include wall prep above and beyond typical Drywall/Masonry surface is required to properly install this contractor’s work. Including Prep of walls where items are demoed as needed to accept the installation of this packages work.
      f. Notify Construction Field Manager of any imperfections that will affect final product.
         Commencement of work indicates this Contractor’s acceptance of substrate conditions.
      g. Provide all patching.
      h. Related cleanup.
      i. Related layout -- This Contractor is responsible for all layouts associated with the installation of their work.

IV. Other Bid Requirements
   1. Alternates
      a. (not used)

   2. Unit Prices
      a. (not used)

   3. Allowances
      a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

   4. Durations – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
      a. Submittal Preparation
      b. Material Delivery from approved submittals
      c. Ceramic Wall Tile Install
d. Ceramic Floor Tile Install

V. Exclusions
   a. (not used)

<End of Bid Package 093>
BID PACKAGE 096 – FLOOR COVERINGS

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Floor Coverings as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Demolition – Complete as related to the work of this contract.
   1. Section 024119 – Selective Demolition – Complete, including, but not limited to the items listed throughout this bid package.
      a. Provide for demolition and patch back of all Flooring Types (VCT, Carpet, Resinous Flooring, etc.), Base, Adhesives, etc. at the locations indicated for installation of all new Flooring and Base installed by this package.
         i. This Contractor will be required to make multiple mobilizations and will be required to provide the necessary manpower for the concurrent projects.
         ii. If the existing flooring is not indicated to be removed but would be required to install this package’s work then this package shall provide such demo at no additional cost to the owner.
         iii. If the existing flooring is not indicated to be removed but would require prep work before placement of this packages flooring, then such prep work is by this package.
         iv. Flooring indicated on Demo Sheets and/or Architectural Plans to Demo must be completely removed regardless if just prepping the floor would be sufficient for this package to install their work.
      b. Removal of debris created by this package to dumpsters is by this package.
      c. Include patching back to like conditions of existing finishes to remain that were altered/damaged as a result of this packages work.
      d. Includes prepping and leveling floor as required to install the new flooring.
      e. This package shall level and feather out floors with Latex grout topping on each side of dissimilar floor elevations as required where construction has been removed to create a smooth level floor for final floor finishes.
      f. Include any sanding, grinding, etc. necessary to complete demo by this package.

III. Division 07 – Moisture Control – Complete as related to the work of this contract.
   1. Section 079200 – Joint Sealants – Complete including, but not limited to the items listed throughout this bid package.
      a. Provide and install Joint Sealants as it pertains to this scope of work. M.E.P. Contractor to provide for own penetrations.

IV. Division 09 – Finishes – Complete as related to the work of this contract.
   1. Section 096513 – Resilient Base and Accessories – Complete in its entirety, including but not limited to the following:
   2. Section 096519 – Resilient Tile Flooring – Complete in its entirety, including but not limited to the following:
      a. Flooring Contractor to provide all appropriate transition trim pieces. Provide samples for Architect/Designer for approval.
   3. Section 096813 – Tile Carpeting – Complete in its entirety, including but not limited to the following:
      a. Contractor to furnish all labor, material, equipment, etc. necessary for a complete installation
of all Resilient Base, Flooring, Carpet, including all prep work, accessories, and cleaning after install.
b. Include leveling and patching compounds and concrete subfloor testing and preparation.
c. Subfloors will be in broom clean condition. Provide any additional cleaning required. Provide sweeping compound and final sweep.
d. Provide leveling and patching compound as needed to create a level surface.
e. Provide all patching.
f. Related cleanup.
g. Related layout — This Contractor is responsible for all layouts associated with the installation of their work from existing control points.
h. Provide shot blasting and all other floor prep required for the installation of this contractor’s work.
i. Provide testing for existing slab moisture content and notify Construction Manager of any levels that are above 90% RH.
j. Include sealers as necessary for moisture levels below 90% in base bid.
k. Provide unit pricing for Sealer if needed for moisture levels above 90% RH.
l. Regardless if drawn or specified, provide transition strips between existing or new flooring and new Resinous Flooring.
m. Provide new carpet (District Added Stock) and rubber as needed.
n. Provide final cleaning of flooring installed by this package as indicated in the sections installed by this package. This shall be done upon notice by Construction Manager at end of project.

V. Other Bid Requirements
1. Alternates
   Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.

2. Unit Prices
   a. Provide unit pricing (per SF) for Sealer if needed for moisture levels above 90% RH.

3. Allowances
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.
   b. Provide a Five Thousand Dollar ($5,000) Force Allowance to be used at the direction of the Construction Manager / Owner.

4. Durations — Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. Material Delivery from approved submittals
   c. Flooring Demo
   d. Flooring and Base Install

VI. Exclusions
   a. (not used)
BID PACKAGE 097 – RESINOUS FLOORING

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Resinous Flooring as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 2 – Section 024119 - Selective Demolition - Complete as related to the work of this contract.
   1. Provide for demolition and patch back of all Flooring Types (VCT, Carpet, Resinous Flooring, Tile Flooring etc.), Base, Adhesives, etc. where indicated to be demoed, at locations where the new Flooring and Base installed by this package is located.
      a. This Contractor will be required to make multiple mobilizations and will be required to provide the necessary manpower for the concurrent projects.
      b. If the existing flooring is not indicated to be removed but would be required to install this package’s work, then this package shall provide such demo at no additional cost to the owner.
      c. If the existing flooring is not indicated to be removed but would require prep work before placement of this package’s flooring, then such prep work is by this package.
      d. Flooring indicated on Demo Sheets and/or Architectural Plans to Demo must be completely removed regardless if just prepping the floor would be sufficient for this package to install their work.
   2. Removal of debris created by this package to dumpsters is by this package.
   3. Include patching back to like conditions of existing finishes to remain that were altered/damaged as a result of this package’s work. Includes prepping and leveling floor as required to install the new flooring.
   4. This package shall level and feather out floors with Latex grout topping on each side of dissimilar floor elevations as required where construction has been removed to create a smooth level floor for final floor finishes. This is also at junctions between new and existing floors.
   5. Include floor prep where old Floor Drains are to be abandoned in place.
   6. Include any sanding, grinding, etc. necessary to complete demo by this package.

III. Division 7 - Section 079200 – Joint Sealants – Complete as related to the work of this contract.
   1. Provide and install Joint Sealants as it pertains to this scope of work. M.E.P. Contractor to provide for own penetrations.

IV. Division 9 – Finishes – Complete as related to the work of this contract.
   1. Section 096723 – Resinous Flooring – Complete this section in their entirety
      a. Furnish all labor, material, equipment and transportation necessary for a complete installation of all resinous Flooring.
      b. Floors will be in broom clean condition. Provide any additional cleaning required. Provide sweeping compound and final sweep.
      c. Provide leveling and patching compound to fill concrete floor saw joints, concrete floor control joints, and as needed to create a level surface
      d. New Resinous Flooring at Café at Prairie Point Elementary. New Resinous Flooring at café at Gerner Family EEC.
      e. Related clean-up
      f. Receiving, handling, and storage responsibility for all installed items.
g. Provide for all testing as required prior to flooring installation and additional testing required by the Construction Manager. Provide Construction Manager the results of testing. If Contractor fails to perform testing and provide results then contractor will warranty floors regardless of moisture content.

h. Include all filling of control joints and cove base substrate.

i. Provide isolation barriers / dust protection as required to maintain this contractor’s work during construction activities.

j. Provide shot blasting and all other floor prep required for the installation of this contractor’s work.

k. Include patching of all Resinous Flooring as required for a complete installation.

l. Include sealers as necessary for moisture levels below 90% in base bid.

m. Provide unit pricing for Sealer if needed for moisture levels above 90% RH.

V. Other Bid Requirements

1. Alternates

   Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.

   a. **Alternate 1** – Includes all labor, materials, equipment and appurtenances to install Resinous Flooring at commons. The base bid will have no work at commons.

2. Unit Prices

   a. Provide unit pricing (per SF) for Sealer if needed for moisture levels above 90% RH.

3. Allowances

   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

   b. Provide a Five Thousand Dollar ($5,000) Force Allowance to be used at the direction of the Construction Manager / Owner.

4. Durations

   Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.

   a. **Submittal Preparation**

   b. **Material Delivery from approved submittals**

   c. **Flooring Demo (Base Bid)**

   d. **Resinous Flooring Install (Base Bid)**

   e. **Flooring Demo (Alternate #1)**

   f. **Resinous Flooring (Alternate #1)**

VI. Exclusions

   a. (not used)
BID PACKAGE 099 – PAINTING

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Painting as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor's scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 07 – Thermal and Moisture Protection – Complete as related to the work of this contract.
   1. Section 079200 – Joint Sealants – Complete, including, but not limited to the items listed throughout this bid package.
      a. Provide and install all joint sealants as required at joints of dissimilar materials.
         i. MEPFT will Seal their penetrations
         ii. Door Frames and casework will be caulked by BP-061
         iii. Caulking of the perimeter of glass systems shall be by BP-088.
         iv. Caulking of plumbing fixtures shall be by BP-220.
         v. Caulking joints between dissimilar materials not mentioned by other above in which at least on is scheduled to paint, shall be by this contractor.

III. Division 09 – Finished – Complete as related to the work of this contract.
   1. Section 099123 – Interior Painting – Complete including, but not limited to the items listed throughout this bid package.
      a. This Contractor to provide all labor and materials necessary for the application of Paint in all areas as required.
      b. Work includes, but is not limited to, surface preparation, application of primer coats and application of finish coats to all exposed exterior and interior items and surfaces throughout the project, unless specified otherwise.
      c. Mechanical, Plumbing and Electrical painting where indicated.
      d. Paint all exposed materials including but not limited to structural steel and miscellaneous exposed metals, conduits, gas piping, duct work, etc. Review all drawings for notes indicating paint.
      e. Contractor shall install first and second coats of paint initially, but shall not install the final coat of paint until directed by the CM. The intent is to hold this coat of paint until the end of the project to eliminate excessive touchup work for the painter on this project.
      f. Protect all adjoining work as required during application of painting materials. Avoid overspray on surrounding areas.
      g. Provide as many coats of paint to produce a uniform finish.
      h. Related cleanup.
         i. Painter is to assume that there will be accent and/or trim colors used in this project.
      j. Related clean-up.
      k. Provide and install all epoxy and other paints as required.
      l. Field Apply all paint coats to all materials that are required to be painted on site. Protect surroundings from dust and debris to ensure proper installation.
      m. Carefully review all drawings and include painting of all surfaces indicated, including painting where patch work is indicated, etc.
      n. Confirm with MEP trades and CM that all Overhead work that requires painting is installed in exposed structure locations before painting the structure.
      o. Wood doors will be provide unfinished by BP-061 and will be field finished to match existing at each location by this contractor.
2. **Section 097200 – Wall Coverings** – Complete this section in its entirety, including but not limited to.
   a. Provide all Wall Covering with the designation "WC_". (i.e Material finish Legend on A681-PHHS).

IV. **Division 10 – Specialties** – Complete as related to the work of this package.
   1. **Section – 101400 – Signage** – Complete as only as specifically listed below.
      a. Provide and install complete all “Wall Vinyl Graphics” designated as “WG_” drawn and/or specified. (i.e. Environmental Graphics Legend - A681-PHHS).

V. **Other Bid Requirements**
   1. **Alternates**
      a. **Alternate #3** – Provide additional painting work as required if Alternate #3 is accepted. 
         (See Page Spec 1 – Alt #3 for details on the additional door and frame work required).

2. **Unit Prices**
   a. (not used)

3. **Allowances**
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

4. **Durations** – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. Wall Covering / Graphics Delivery from approved submittals
   c. Paint 1st and 2nd Coats
   d. Paint final coat

VI. **Exclusions**
   a. (not used)

<End of Bid Package 099>
BID PACKAGE 102 – OPERABLE PANEL PARTITIONS

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Operable Panel Partitions as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Demolition – Complete as related to the work of this contract.
   1. Section 024119 – Selective Demolition – Complete, including, but not limited to the items listed throughout this bid package.
      a. This Contractor will be required to make multiple mobilizations and will be required to provide the necessary manpower for the concurrent projects.
      b. Existing panels and track to red iron are to be removed by the demolition package. This package to include any additional demolition as required for a complete installation.
      c. Conform to all general and demolition notes as related to this packages scope of work.

III. Division 10 – Finishes – Complete as related to the work of this contract.
   1. Section 102239 – Glass Operable Partitions – Complete including, but not limited to the items listed throughout this bid package.
      a. This contractor shall furnish all material, labor and equipment to install all operable panel partitions, including miscellaneous materials and accessories as described in the contract documents or required for a complete installation where specified.
      b. Conform to all General, Architectural and plan notes as related to this packages scope of work.
      c. Receiving, handling and storage for any and all materials, equipment, and/or other misc. items pertaining to this scope of work as outlined is the responsibility of this package.
      d. Related layout – This Contractor is responsible for all layouts associated with the installation of their work from existing control points.
      e. Provide all components to provide a complete installation of the partitions include marker boards (mb), tack boards (tb), supports, doors, etc. Field verify existing conditions.
      f. Structural Steel supports shown on drawings will be BP-051. Any additional supports will be by this package.

IV. Other Bid Requirements
   1. Alternates
      Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.

   2. Unit Prices
      a. (not used)

   3. Allowances
      a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

   4. Durations – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
      a. Submittal Preparation
      b. Material Delivery from approved submittals
c.  *Partition Install*

V.  *Exclusions*
   a.  *(not used)*

(END OF BID PACKAGE 102)
BID PACKAGE 114 – FOOD SERVICE EQUIPMENT

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Food Service Equipment as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 7 – Thermal and Moisture Protection – Complete as related to the work of this contract.
   1. Section 079200 – Joint Sealants – As related to this scope of work
      a. Provide and install Joint Sealants as it pertains to this scope of work. M.E.P. Contractor to provide for own penetrations.

III. Division 11 – Equipment – Complete as related to the work of this contract.
   1. Section 114000 – Food Service Equipment – Complete in its entirety, including, but not limited to the following:
      a. Provide and install all Food Service Equipment as drawn and/or specified.
      b. This Contractor will be required to make multiple mobilizations, and will be required to provide the necessary manpower for the concurrent projects.
      c. Related layout -- This Contractor is responsible for all layouts associated with the installation of their work from existing control points. Including but not limited to checking and verifying all rough-ins.
      d. It is this Contractor’s Responsibility to have a single source point of connection for final hookup by MEPFT.
      e. This contractor is responsible for any penetrations as required to complete the work of this package. Coordinate with other trades as required. Includes coordinating wall opens as necessary.
      f. Provide and install disconnects when required for equipment furnished by this package. Wiring from Equipment to Disconnects is by the work of this package. Wiring and connection from Panel to Disconnect is by Electrical Contractor. Coordinate with Electrical Contractor as required. This Contractor is to provide, install, and connect any electrical whips required for their equipment that is to not receive a hard-wired connection from the panel.
      g. Provide the equipment furnished by this package indicated to be hard wired, with a single point of connection for electrical service to such equipment. Electrical Contractor to provide connection from panel to equipment as required.
      h. Provide (Furnish, Deliver, and Install) all Kitchen Equipment in its entirety. This includes all items, miscellaneous items, brackets, shelves, tops, etc. as necessary to complete the Food Service Equipment (Reference K100, K101, and K102 for the equipment schedule at Park Hill South High School).
      i. This contractor should include work required to relocate existing Food Service Equipment and modifications to such equipment as required. Include multiple mobilizations as required.
      j. MEPFT connections will be by appropriate MEPFT Trade
      k. This contractor is required to visit site for existing conditions prior to bid and include all work required that can be accounted for by a site visit. CM will schedule a walk through of the existing facility prior to bid.
      l. This contractor should review All Drawings to ensure they have all work required by this scope. Including but not limited to providing and installing ALL stainless steel work surfaces, backsplashes, panels, protective guards, sheets, reveals, covers, tops, tables, etc. as required.
      m. Provide for cleaning of all kitchen equipment.

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m. Provide for caulking as related to this contract.

n. Motor starters will be provided and installed by package providing equipment.
   i. If the Motor Starter is drawn to be on the exterior of the equipment (e.g. wall mounted away from equipment) it will be provided and installed by package providing equipment for Electrical Package to make connection to starter and from starter to single point of connection at equipment and include any raceways required. If it is to be mounted to the equipment or inside the equipment cabinet than Electrical Contractor will only make the single point of connection to the equipment and any internal wiring/raceways is by package providing the equipment.

o. Include relocating ALL existing Food Service Equipment, Shelves, Tables, Stainless Racks, etc. that is reused in the new spaces, to a storage in an area within the building as directed by CM/Owner. Include Protection of such items during move and while stored, to include all means necessary to protect (poly/cardboard/plywood/etc.) such during storage. Take Pictures of Existing Equipment prior to removal to storage area, after placement in storage area, prior to moving back into Kitchen area, and after final placement. Notify Construction Manager immediately of any damage to the equipment prior to initial move to storage area.
   i. Replace/Repair any items damaged as a result of this contractor’s work.
   ii. MEPFT trades will disconnect and reconnect any such items. Mechanical will remove any Kitchen Exhaust Hoods
   iii. Intent is to completely remove all items from the space during construction whether identified or not on plans and such shall be included as part of bid.

p. Provide temporary protection of all installed equipment. Do not remove plastic, coverings, etc. until directed by Construction Manager.

IV. Other Bid Requirements

1. Alternates
   Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.

2. Unit Prices
   a. (not used)

3. Allowances
   a. Provide a composite cleanup allowance of 1/2% of contract value per section 017419.

4. Durations – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. Material Delivery from approved submittals
   c. Equipment Install

V. Exclusions
   a. (not used)

<End of Bid Package 114>
BID PACKAGE 210 – FIRE SUPPRESSION

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Fire Suppression as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Demolition / Existing Conditions – Complete as related to the work of this contract.
1. Section 024119 – Selective Demolition – Complete, including, but not limited to the items listed throughout this bid package.
   a. Cut loose and drop all plumbing items shown or schedule to be demo’d to the floor for removal by other. Salvage and protect any existing sprinkler items to be relocated and/or reinstalled.
   b. Demolition and patch-back of walls, slabs and ceilings as required to accommodate Mechanical, Electrical, Plumbing, and/or Fire protection packages (MEPF) as shown on Demo and Architectural Plan(s) will be by others but this package must coordinate with them to minimize over demolition prior to demo.
      i. If demolition and patch-back is required to install this packages work, but is not specifically shown on the Architectural Demo Plan (AD Drawings), then the required demo and patch back shall be provided by this contractor.
         1. Contractor shall reference as-built drawings and/or x-ray prior to trenching, cutting, etc. for any such work.
         2. Where this contractor is responsible for saw cutting, excavating, shoring, backfill & compaction, core drilling, sleeves, penetrations, slab trenching, & debris removal as required for installation of the work associated with this package above and below slab, along with making any penetrations in existing walls and/or where contractor failed to coordinate in advance with new construction in order to accommodate the installation of this packages work.
         3. All patching and repairs required in existing walls, ceiling, floors, concrete etc. that had to be removed to complete the installation of this packages work shall be completed by this package to include patching, painting, caulking, etc. back to like condition and done in a manner so that this package can sell such work to Owner/Architect.
         4. Reinstall (or replace if damaged) all ceiling tiles and grid removed by this package to complete their work.
         5. Protection of surrounding finishes during any cutting/patching made by this package will be the responsibility of this package and shall include all cleanup.

III. Division 07 – Moisture Control and Insulation – Complete as related to the work of this contract.
1. Section 072100 – Thermal Insulation – Complete including, but not limited to the items listed throughout this bid package.
2. Section 078413 – Penetration Firestopping – Complete including, but not limited to the items listed throughout this bid package.
3. Section 079200 – Sealants – Complete including, but not limited to the items listed throughout this bid package.
   a. Provide thermal insulation as required for this scope of work includes but not limited to insulation required for penetrations, sound barriers, etc.
   b. Include all piping insulation required for new or modified working installed by this
c. Provide and install Joint Sealants as it pertains to the installation of this contractor's work only.
d. Provide and install firestopping at all locations where you new work penetrates a rated assembly.

IV. Division 08 – Openings - Complete as related to the work of this contract.
   1. Section 083113 – Access Doors – Complete as related to the work of this contract.
      a. This Contractor is to furnish and install all access panels required for a complete installation of their work.
      b. If access panels are required for this packages work, the size and location must be approved by the A/E prior to installation and after such approval the installation will be this packages responsibility.

V. Division 21 – Fire Suppression – Complete, the requirements of this section in their entirety, including as drawn, specified and/or reasonably inferred by the documents for all work required under all sections listed in the Table of Contents within this Division. Including but not limited to the items indicated in this package.
   1. Section 210500 - Common work Results of Fire Suppression - Complete, including but not limited to the items listed in this bid package.
   2. Section 211100 Facility Fire Suppression Water Service Piping - Complete, including but not limited to the items listed in this bid package.
   3. Section 211313 Wet-Pipe Sprinkler Systems - Complete, including, but not limited to the items listed in this bid package.
      c. Provide all work above ceiling to make tie-ins and rework existing as required.
      d. Coordinate with other trades in the field in establishing final ceiling heights. Final ceiling heights may vary from design ceiling heights as a result of field conditions and/or on site coordination. These final adjustments will be at no additional cost to the Owner.
      e. Demolition and patch-back of walls as required to accommodate Mechanical, Electrical, Plumbing, and/or Fire protection packages (MEPF) as indicated on Architectural and Demo Drawings will be by BP – 061 but this package must coordinate with them to minimize over demolition prior to demo. Other demolition and patch-back to match existing that may be required but is not shown to accommodate installation of this packages work shall be provided and installed complete by this package.
         i. If ceilings are not called to be removed but would be required to complete this packages work it will this packages responsibility to remove and replace/patch ceilings back to original state as necessary to complete this installation of this packages work.
      f. Required permits are provided by this package.
      g. Related Layout – This Contractor is responsible for all layouts associated with the installation of their work from existing control points.
      h. Related cleanup.
         i. Patching and repairs as required which are created by this package.
      j. If any concrete pads are required for the installation of this packages work it is to be provided and installed by this package.
      k. Include removal, relocation, and new connections as it pertains to the Fire Protection System where required for owner provided equipment, kitchen equipment, etc. as necessary.
      l. Provide all cutting, core drillings, sleeve, penetrations, etc. as required for installation of the work of this package.
      m. AVOID INTERRUPTION OF BUILDING ACTIVITIES, COORDINATE WITH CM FOR SUCH IN ADVANCE. IF SUCH INTERRUPTIONS ARE NECESSARY THEY SHALL BE DONE AFTER HOURS.
      n. This package shall demo all work associated with this package inside the building as
required. All materials demo’d shall be removed to the onsite dumpsters by this package.

o. Coordinate with other trades where required the installation of this packages work
   including Plumbing/Mechanical/Electrical.

p. Rework of Existing Areas and extend into new areas as necessary in order to maintain fire
   protection per codes/drawings/AHJ.

q. Disconnect and Reconnect all Fire Suppression work associated with Food Service
   Equipment/Kitchen Equipment in the Kitchen regardless if indicated or not. The intent is to
   remove these items during construction activities. Visit Site Prior to Bid as necessary to
   establish full extent of work.

r. Provide new escutcheons where new ceilings are called for in existing spaces.

s. Piping for revisions to the work on the 5th Floor of the Innovation Studio may be plastic pipe to
   match existing. (Field verify actual material used prior to bid).

t. Provide engineered shop drawings for all revisions.

u. Note: None of the ceilings at LEAD Innovation Studio are scheduled to demo. BP-092 shall
   remove the ceiling tile in rooms A100, A101, A103 prior to commencement of work and BP-
   092 shall reinstall that tile at the completion of the above ceiling work. All ceiling tile outside
   of these rooms shall be removed and installed by you as required to complete your new
   sprinkler work.

VI. Other Bid Requirements

1. Alternates
   a. (not used)

2. Unit Prices
   a. (not used)

3. Allowances
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

4. Durations – Provide the number of working days required for each of the following activities on
   bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. Overhead Rough-in
   c. Overhead Trim Out

VII. Exclusions

a. (not used)

<End of Bid Package 210>
BID PACKAGE 220 – PLUMBING

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Plumbing as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor's scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Demolition / Existing Conditions – Complete as related to the work of this contract.
   1. Section 024119 – Selective Demolition – Complete, including, but not limited to the items listed throughout this bid package.
      a. Cut loose and drop all plumbing items shown or schedule to be demo’d to the floor for removal by other. Salvage and protect any existing plumbing items to be relocated and/or reinstalled.
      b. Plan Note 2 on DM101A – PHHS and General Mechanical Note #7 (on all “DM_” pages) shall be by BP-220.
      c. Complete all work as shown on DP101G and DP201G all at PHSHS.
      d. Demolition and patch-back of walls, slabs and ceilings as required to accommodate Mechanical, Electrical, Plumbing, and/or Fire protection packages (MEPF) as shown on Demo and Architectural Plan(s) will be by others but this package must coordinate with them to minimize over demolition prior to demo.
         i. If demolition and patch-back is required to install this packages work, but is not specifically shown on the Architectural Demo Plan (AD Drawings), then the required demo and patch back shall be provided by this contractor.
            1. Contractor shall reference as-built drawings and/or x-ray prior to trenching, cutting, etc. for any such work.
            2. Where this contractor is responsible for saw cutting, excavating, shoring, backfill & compaction, core drilling, sleeves, penetrations, slab trenching, & debris removal as required for installation of the work associated with this package above and below slab, along with making any penetrations in existing walls and/or where contractor failed to coordinate in advance with new construction in order to accommodate the installation of this packages work.
            3. All patching and repairs required in existing walls, ceiling, floors, concrete etc. that had to be removed to complete the installation of this packages work shall be completed by this package to include patching, painting, caulking, etc. back to like condition and done in a manner so that this package can sell such work to Owner/Architect.
            4. Reinstall (or replace if damaged) all ceiling tiles and grid removed by this package to complete their work.
            5. Protection of surrounding finishes during any cutting/patching made by this package will be the responsibility of this package and shall include all cleanup.
      e. Demo and patch back roofing at all new plumbing piping penetrations at the roof. Revisions to steel for these openings shall be by BP-51 but coordinated by this contractor.

III. Division 03 – Concrete – Complete as related to the work of this contract.
   1. Section 030000 – Concrete – Complete including, but not limited to the items listed throughout this bid package.
      a. Provide and install concrete housekeeping pads, thrust blocks, vaults, etc. as required,
drawn, specified, etc. to complete the installation of this packages work if not specifically shown on the drawings, but is required for your new work. Include providing and installing all reinforcing, materials, accessories as required for a complete installation of this concrete.

b. For any slabs removed as part by this Contractor demo work, the Concrete patch back material must be an Emaco quick cure product compatible with applicable flooring system to be installed, coordinate with flooring contractor as required.

IV. Division 07 – Moisture Control and Insulation – Complete as related to the work of this contract.

1. Section 072100 – Thermal Insulation – Complete including, but not limited to the items listed throughout this bid package.
2. Section 078413 – Penetration Firestopping – Complete including, but not limited to the items listed throughout this bid package.
3. Section 079200 – Sealants – Complete including, but not limited to the items listed throughout this bid package.
   i. Provide thermal insulation as required for this scope of work includes but not limited to insulation required for penetrations, sound barriers, etc.
   ii. Include all piping insulation required for new or modified working installed by this contractor’s work.
   iii. Provide and install Joint Sealants as it pertains to the installation of this contractors work only.
   iv. Provide and install firestopping at all locations where your new work penetrates a rated assembly.

V. Division 08 – Openings - Complete as related to the work of this contract.

1. Section 083113 – Access Doors – Complete as related to the work of this contract.
   a. This Contractor is to furnish and install all access panels required for a complete installation of their work.
   b. If access panels are required for this packages work, the size and location must be approved by the A/E prior to installation and after such approval the installation will be this packages responsibility.

VI. Division 22 – Plumbing – Complete, the requirements of this section in their entirety, including as drawn, specified and/or reasonably inferred by the documents for all work required under all sections listed in the Table of Contents within this Division. Including but not limited to the items indicated in this package.

1. All necessary hoisting and staging.
2. Related cleanup.
3. Where piping is exposed in areas such as chases, or other serviceable areas such piping shall be routed in a manner that would permit as much access for serviceability as possible.
4. Provide Sleeves and penetrations as required.
5. Contractors shall respond to reported system problems within 24 hours and shall make repairs within 48 hours. Repairs shall be coordinated with and documented to the Construction Manager.
6. AVOID INTERRUPTION OF SCHOOL ACTIVITIES, COORDINATE WITH CM FOR SUCH IN ADVANCE. IF SUCH INTERRUPTIONS ARE NECESSARY THEY SHALL BE DONE AFTER SCHOOL HOURS.
7. Excludes painting.
8. Related Layout – This Contractor is responsible for all layouts associated with the installation of their work from existing control points.
9. This Contractor is responsible to make all disconnections/reconnections and/or new connections of piping/items that would fall under this scope for any new/existing owner equipment, etc.
10. Required Permits.
11. Provide all equipment, materials, labor, etc. necessary for the complete installation of the Gas Piping.
12. Provide and install all gas piping & misc. components including but not limited to valves, support blocking & strapping on roof, isolation cabinets & misc accessories, regulators, gas cocks, dirt legs, unions, etc. as require for complete system.
13. Include all plumber work required to install all plumbing equipment called out on the “Plumbing Fixture Schedule” and “Drain Schedule” on Sheet ME301-PHHS & ME301 - PHSHS.
14. Include all work shown on M201A-PHHS unless specifically excluded.
15. Include all work shown on P101G, P201A and P201G all at PHSHS.
16. Provide and install all Grease Interceptors.
17. It is the responsibility of this Contractor to provide coordination drawings and onsite coordination as required with other trades.
19. Coordination with HVAC, Electrical and Fire Protection Contractor is required.
20. Include all necessary tie-ins to existing of systems, piping, equipment that is installed by this package.
21. This Contractor should provide equipment with power requirements indicated with a single point of connection for BP-260 to connect. If Power requirements of Equipment provided by this contractor differ than those indicated in documents, it will be this contractor’s responsibility to provide all electrical components to power such equipment. Especially if conductors/power is existing to remain. This Contractor should coordinate in advance with BP-260 their power requirements in advance.

22. **Roof/Wall Penetrations and Embeds**
   a. Provide all penetrations as required for the work of this package. These penetrations will be flashed in and made weather tight by this contractor.
   b. Provide and install this packages work where required to be embedded into Masonry or other walls. This includes providing and installing all conduits, sleeves, penetrations, etc. as required. Coordinate with Corresponding Contractors as required, includes providing shop drawings, attending preconstruction meetings, etc.
   c. Provide all bird screen/wire covers for pipes are drawn or specified. Including all overflow drains, vent pipes, etc.

23. If Ceiling Tile is not shown to Demo on Architectural Demolishing Plan, then provide for removal and reinstallation of ceiling tile to accommodate tie-ins required by this package. Include replacement of damaged tile caused by this packages work. Include floor/wall protection as required. Take pictures of existing conditions and submit to CM prior to working in any existing areas.

24. This package must leave sleeves for all penetrations where possible. If Core Drilling is required then this package will be required to coordinate with CM in advance, and will be responsible for protecting finishes, and cleaning after core drilling. No Core Drilling shall commence without approval from Construction Manager.

25. Cutting/Thread Machines will not be allowed inside existing building space without prior approval from Construction Manager. Anticipate cutting/threading of pipes outside. If such machines are allowed within the construction space this contractor will be required to include floor and wall protection, regardless if finishes are installed. Include cleanup daily as required.

26. Disconnect and Reconnect all Plumbing items in the Kitchen regardless if indicated or not. The intent is to remove these items during construction activities. Visit Site Prior to Bid as necessary to establish full extent of work.

27. Include work required for Plumbing items to accommodate the installation of new ceilings. Include removal, store and reinstall. Take Pictures prior to removal of all items handled by this package.

28. Provide all work called out by “plumbing contractor” on K100, K101 and K102 at PHSHS.

**VII. Other Bid Requirements**

1. **Alternates**
   a. (not used)

2. **Unit Prices**
   a. (not used)

3. **Allowances**
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.
   b. Provide a $5,000 Force Allowance for sole use by the Construction Manager. Unused
Allowances will be returned to the Owner.

4. **Durations** – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. **Submittal Preparation**
   b. **Fixture Delivery from approved submittals**
   c. **Overhead Rough-in**
   d. **Wall Rough-in**
   e. **Wall Trim Out**

**VIII. Exclusions**
   a. *(not used)*

<End of Bid Package 220>
BID PACKAGE 230 – HVAC

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the HVAC as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor’s scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Demolition / Existing Conditions – Complete as related to the work of this contract.
   1. Section 024119 – Selective Demolition – Complete, including, but not limited to the items listed throughout this bid package.
      a. Cut loose and drop all HVAC items shown or schedule to be demo’d to the floor for removal by other. Salvage and protect any existing HVAC items to be relocated and/or reinstalled.
         i. Plan Note 2 on DM101A – PHHS and General Mechanical Note #7 (on all pages listed above) shall be by BP-220.
      c. Demolition and patch-back of walls, slabs and ceilings as required to accommodate Mechanical, Electrical, Plumbing, and/or Fire protection packages (MEPF) as shown on Demo and Architectural Plan(s) will be by others but this package must coordinate with them to minimize over demolition prior to demo.
         i. If demolition and patch-back is required to install this packages work, but is not specifically shown on the Architectural Demo Plan (AD Drawings), then the required demo and patch back shall be provided by this contractor.
            1. Contractor shall reference as-built drawings and/or x-ray prior to trenching, cutting, etc. for any such work.
            2. Where this contractor is responsible for saw cutting, excavating, shoring, backfill & compaction, core drilling, sleeves, penetrations, slab trenching, & debris removal as required for installation of the work associated with this package above and below slab, along with making any penetrations in existing walls and/or where contractor failed to coordinate in advance with new construction in order to accommodate the installation of this packages work.
            3. All patching and repairs required in existing walls, ceiling, floors, concrete etc. that had to be removed to complete the installation of this packages work shall be completed by this package to include patching, painting, caulking, etc. back to like condition and done in a manner so that this package can sell such work to Owner/Architect.
            4. Reinstall (or replace if damaged) all ceiling tiles and grid removed by this package to complete their work.
            5. Protection of surrounding finishes during any cutting/patching made by this package will be the responsibility of this package and shall include all cleanup.
      d. This package should carefully review all drawings for ceiling removal and replacement, including Demo, RCP, and Finish schedules. Where such indicate either Demo or new ceilings this package should remove, store onsite and reinstall, any HVAC fixtures/devices as required to accommodate new ceiling installation. Field Verify as required.
      e. Demo and patch back roofing at all new HVAC & VRF Piping penetrations at the roof.
Revisions to steel for these openings shall be by BP-51 but coordinated by this contractor.

III. Division 03 – Concrete – Complete as related to the work of this contract.
   1. Section 030000 – Concrete – Complete including, but not limited to the items listed throughout this bid package.
      a. Provide and install concrete housekeeping pads, thrust blocks, vaults, etc. as required, drawn, specified, etc. to complete the installation of this package’s work if not specifically shown on the drawings, but is required for your new work. Include providing and installing all reinforcing, materials, accessories as required for a complete installation of this concrete.
      b. For any slabs removed as part by this Contractor demo work, the Concrete patch back material must be an Emaco quick cure product compatible with applicable flooring system to be installed, coordinate with flooring contractor as required.

IV. Division 07 – Moisture Control and Insulation – Complete as related to the work of this contract.
   1. Section 072100 – Thermal Insulation – Complete including, but not limited to the items listed throughout this bid package.
   2. Section 078413 – Penetration Firestopping – Complete including, but not limited to the items listed throughout this bid package.
   3. Section 079200 – Sealants – Complete including, but not limited to the items listed throughout this bid package.
      i. Provide thermal insulation as required for this scope of work includes but not limited to insulation required for penetrations, sound barriers, etc.
      ii. Include all duct and piping insulation required for new or modified working installed by this contractor’s work.
      iii. Provide and install Joint Sealants as it pertains to the installation of this contractor’s work only.
      iv. Provide and install firestopping at all locations where your new work penetrates a rated assembly.

V. Division 08 – Openings - Complete as related to the work of this contract.
   1. Section 083113 – Access Doors – Complete as related to the work of this contract.
      a. This Contractor is to furnish and install all access panels required for a complete installation of their work.
      b. If access panels are required for this package’s work, the size and location must be approved by the A/E prior to installation and after such approval the installation will be this package’s responsibility.

VI. Division 23 – Heating, Venting and Air Conditioning – Complete, the requirements of this section in their entirety, including as drawn, specified and/or reasonably inferred by the documents for all work required under all sections listed in the Table of Contents within this Division. Including but not limited to the items indicated in this package.
   1. Part 1 – General Requirements – HVAC and Fire Protection – Sheet ME201, LEAD Innovation Studio, as it specifically relates to HVAC work only.
   2. Part 2 – Heating, Ventilating and Air Conditions – Sheet ME201, LEAD Innovation Studio
   3. All manual, rated or motorized Ductwork dampers shall be provided by this contractor. Power for any motorized damper shall be by BP-260.
   4. All necessary hoisting and staging.
   5. Related cleanup.
   6. Where piping is exposed in areas such as chases, or other serviceable areas such piping shall be routed in a manner that would permit as much access for serviceability as possible.
   7. Provide Sleeves and penetrations as required.
   8. Contractors shall respond to reported system problems within 24 hours and make repairs within 48 hours. Repairs shall be coordinated with and documented to the Construction Manager.
   9. AVOID INTERRUPTION OF BUILDING ACTIVITIES, COORDINATE WITH CM FOR SUCH IN ADVANCE. IF SUCH INTERRUPTIONS ARE NECESSARY THEY SHALL BE DONE AFTER
BUILDING HOURS.
10. Excludes painting.
11. Related Layout – This Contractor is responsible for all layouts associated with the installation of their work from existing control points.
12. This Contractor is responsible to make all disconnections/reconnections and/or new connections of items that would fall under this scope for any new/existing owner equipment, etc.
13. Required Permits.
14. New HVAC units should anticipate being utilized for temporary conditioning prior to Substantial Completion.
15. Provide maintenance on these units as required until Substantial Completion. Warranties for all Mechanical equipment will begin at Substantial Completion, not equipment start-up. Provide new filters for Mechanical systems serving the construction area at Substantial Completion of the project.
16. Contractor to perform start-up, controls, programming, and field verifications needed to provide fully functioning cooling and heating systems. Signed documentation of tests and verifications shall be submitted for approval of the engineer. A qualified Contractor’s representative shall be on-site to perform and coordinate the following items.
17. This package shall provide and install ALL work required by Sheet ME301 – PHHS & PHSHS, Unless specifically excluded below.
   a. Plumbing fixture schedule and drain schedule work is by BP-220.
   b. Wiring and a single point of power connections for the scheduled equipment is by BP-260.
   c. Overcurrent protection devices shall be provided and installed by BP-260, unless the equipment provided by the HVAC requires a larger breaker. In that case the HVAC contractor shall provide the larger breaker to BP-260 to install.
   d. Disconnects shall be provide and installed per BP-260 unless identified as “integral” or “Provided with VDF” on the schedule. Any disconnects listed as “integral” or “provided with VDF” shall be provided as part of the unit by BP-230 and powered up by BP-260.
   e. This Contractor is to provide, install, and connect any electrical whips required for their equipment that is not to receive a hard wired connection from the panel.
18. Provide and install all work as called out on Sheet M301 – PHHS, M101A and M101G - PHSHS.
19. This Contractor should provide equipment with power requirements indicated. If Power requirements of Equipment provided by this contractor differ than those indicated in documents, it will be this contractor’s responsibility to provide all electrical components to power such equipment. Especially if conductors/power is existing to remain. This Contractor should coordinate in advance with BP-260 their power requirements in advance.
20. Coordinate locations for VRF Units with ceiling grid layout and lighting to ensure proper installation of all systems within the space.
21. It is the responsibility of this Contractor to provide coordination drawings and onsite coordination as required with other trades.
22. Condensate Drain Piping is by BP-220. Condensate Ductwork is by BP-230.
23. Coordination with Plumbing, Electrical and Fire Protection Contractor is required.
24. Include all necessary tie-ins to existing of systems, and equipment that is installed by this package.
25. New and relocated Building Control systems (BMS) shall be by this contractor complete, less raceways and boxes for T-Stats which are shown in new walls. Those specific raceways shall be installed by BP-260. Any other raceways required for the BMS shall be provided and installed by this contractor.
26. Roof/Wall Penetrations and Embeds
   a. Provide and set all roof curbs and make penetrations as required for the work of this package. These penetrations will be flashed in and made weather tight by this contractor. Steel work for these openings shall be by BP-051.
   b. Provide and install this packages work where required to be embedded into Masonry or other walls. This includes providing and installing all conduits, sleeves, penetrations, etc. as required. Coordinate with Corresponding Contractors as required, includes providing shop drawings, attending reconstruction meetings, etc.
27. If Ceiling Tile is not shown to Demo on Architectural Demolishing Plan, then provide for removal
and reinstallation of ceiling tile to accommodate tie-ins required by this package. Include replacement of damaged tile caused by this package’s work. Include floor/wall protection as required. Take pictures of existing conditions and submit to CM prior to working in any existing areas.

28. This package must leave sleeves for all penetrations where possible. If Core Drilling or saw cutting is required then this package will be required to coordinate with CM in advance, and will be responsible for protecting finishes, and cleaning after core drilling. No Core Drilling shall commence without approval from Construction Manager.

29. Cutting/Thread Machines will not be allowed inside existing building space without prior approval from Construction Manager. Anticipate cutting/threading of pipes outside. If such machines are allowed within the construction space this contractor will be required to include floor and wall protection, regardless if finishes are installed. Include cleanup daily as required.

30. Disconnect and Reconnect all HVAC items in the Kitchen regardless if indicated or not. The intent is to remove these items during construction activities. Visit Site Prior to Bid as necessary to establish full extent of work.
   a. If Exhaust hoods are indicated existing to remain this contractor will disconnect, temporarily remove, store, protect, and then reinstall. Take Pictures prior to removal of such and notify Construction Manager of any damage.

31. Include work required for HVAC items to accommodate the installation of new ceilings. If new Grilles, Diffusers, etc. are not called out, then this package shall remove existing, store and reinstall. Take Pictures prior to removal of all items handled by this package.

32. Note: None of the ceilings at LEAD Innovation Studio are scheduled to demo. BP-092 shall remove the ceiling tile in rooms A100, A101, A103 prior to commencement of demo and BP-092 shall reinstall that tile at the completion of the above ceiling work. All ceiling tile outside of these rooms shall be removed and installed by you as required to complete your new HVAC work.

33. If the contractor plans to reuse flex duct for the new work at LEAD Innovation center, it shall be the contractor’s responsibility to field verify the existing material is adequate for reuse. If it is not, the contractor shall install new flex duct as required.

34. Include all duct cleaning and Test and Balance Work as called out on the contract documents.

35. Provide all work called out by “mechanical contractor” on K100, K101 and K102 at PHS SHS.

VII. Other Bid Requirements
1. Alternates
   a. (not used)

2. Unit Prices
   a. (not used)

3. Allowances
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.
   b. Provide a $5,000 Force Allowance for sole use by the Construction Manager. Unused Allowances will be returned to the Owner.

4. Durations – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. HVAC Equipment Delivery from approved submittals
   c. HVAC Demo
   d. Overhead Rough-in
   e. Overhead Trim Out
   f. Test & Balance Work

VIII. Exclusions
   a. (not used)
<End of Bid Package 230>
BID PACKAGE 260 – ELECTRICAL

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Electrical as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor's scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.

II. Division 02 – Demolition / Existing Conditions – Complete as related to the work of this contract.
   1. Section 024119 – Selective Demolition – Complete, including, but not limited to the items listed throughout this bid package.
      a. Cut loose and drop all electrical items shown or schedule to be demo’d to the floor for removal by other. Salvage and protect any existing electrical items to be relocated and/or reinstalled.
      c. Include all demo as shown on Sheets DE101A, DE101G, DE201A and DE201G for Park Hill South High School.
      d. Demolition and patch-back of walls, slabs and ceilings as required to accommodate Mechanical, Electrical, Plumbing, and/or Fire protection packages (MEPF) as shown on Demo and Architectural Plan(s) will be by others but this package must coordinate with them to minimize over demolition prior to demo.
         i. If demolition and patch-back is required to install this packages work, but is not specifically shown on the Architectural Demo Plan (AD Drawings), then the required demo and patch back shall be provided by this contractor.
            1. Contractor shall reference as-built drawings and/or x-ray prior to trenching, cutting, etc. for any such work.
            2. Where this contractor is responsible for saw cutting, excavating, shoring, backfill & compaction, core drilling, sleeves, penetrations, slab trenching, & debris removal as required for installation of the work associated with this package above and below slab, along with making any penetrations in existing walls and/or where contractor failed to coordinate in advance with new construction in order to accommodate the installation of this packages work.
            3. All patching and repairs required in existing walls, ceiling, floors, concrete etc. that had to be removed to complete the installation of this packages work shall be completed by this package to include patching, painting, caulking, etc. back to like condition and done in a manner so that this package can sell such work to Owner/Architect.
            4. Reinstall (or replace if damaged) all ceiling tiles and grid removed by this package to complete their work.
            5. Protection of surrounding finishes during any cutting/patching made by this package will be the responsibility of this package and shall include all cleanup.
      e. Provide electrical demo as required for mechanical and other equipment as drawn and/or specified.
      f. This package should carefully review all drawings for ceiling removal and replacement, including Demo, RCP, and Finish schedules. Where such indicate either Demo or new ceilings this package should remove, store onsite and reinstall, any Electrical fixtures/devices as required to accommodate new ceiling installation. Field Verify as required. If Fixtures can be hung from Ceiling but do not conflict with installation of
Telecommunications Cable Tray, etc. then this package can hang such from structure. Coordinate with BP-270 and CM as required.

i. Provide new fixtures/devices where indicated on drawings.

g. Demo and patch back roofing at all new Electrical penetrations at the roof. Revisions to steel for these openings shall be by BP-51 but coordinated by this contractor.

III. Division 03 – Concrete – Complete as related to the work of this contract.

1. Section 030000 – Concrete – Complete including, but not limited to the items listed throughout this bid package.
   a. Provide and install concrete housekeeping pads, thrust blocks, vaults, etc. as required, drawn, specified, etc. to complete the installation of this packages work if not specifically shown on the drawings, but is required for your new work. Include providing and installing all reinforcing, materials, accessories as required for a complete installation of this concrete.
   b. For any slabs removed as part by this Contractor demo work, the Concrete patch back material must be an Emaco quick cure product compatible with applicable flooring system to be installed, coordinate with flooring contractor as required.

IV. Division 07 – Moisture Control and Insulation – Complete as related to the work of this contract.

1. Section 078413 – Penetration Firestopping – Complete including, but not limited to the items listed throughout this bid package.
2. Section 079200 – Sealants – Complete including, but not limited to the items listed throughout this bid package.
   a. Provide and install Joint Sealants as it pertains to the installation of this contractors work only.
   b. Provide and install firestopping at all locations where your new work penetrates a rated assembly.

V. Division 08 – Openings - Complete as related to the work of this contract.

1. Section 083113 – Access Doors – Complete as related to the work of this contract.
   a. This Contractor is to furnish and install all access panels required for a complete installation of their work.
   b. If access panels are required for this packages work, the size and location must be approved by the A/E prior to installation and after such approval the installation will be this packages responsibility.

VI. Division 26 – Electrical – Complete, the requirements of this section in their entirety, including as drawn, specified and/or reasonably inferred by the documents for all work required under all sections listed in the Table of Contents within this Division. Including but not limited to the items indicated in this package.

2. Sheets ME 202 and ME203, Lead Innovation Studio, as specified complete.
5. This contractor shall provide and install all light fixtures, except Fixture Type “A” and “AX” at both PHHS and PHSHS. The District will furnish and deliver these to each site based upon contractor provided quantities. BP-260 shall receive and install all Fixture type “A” and “AX” fixtures.
6. Fire Smoke Dampers shall be provide by BP-230 and powered up by this contractor.
7. Provide all Infrastructure, Raceways, Boxes, Devices, Lights, etc. necessary for a complete installation.
   a. Equipment Provide by others will be provided with a single point of connection for this package to connect to.
   b. Coordinate power requirements with other trades and owner provided equipment prior to starting construction.
8. Provide power requirements and electrical connections to all equipment, furnishings, etc. requiring electric power including, but not limited to, indicated or not indicated – handicap assist door operators, magnetic hold-open devices, all disconnects, other systems requiring power, etc…
9. This package is to include all whips, materials, accessories etc. necessary to complete the installation of this packages work.
10. Provide and install disconnects and motor starters when required for equipment furnished by this package.
   a. Wiring and a single point of power connections for the scheduled equipment is by BP-260.
   b. Overcurrent protection devices shall be provided and installed by BP-260, unless the equipment provided by the HVAC requires a larger breaker. In that case the HVAC contractor shall provide the larger breaker to BP-260 to install.
   c. Disconnects and/or motor starters shall be provide and installed per BP-260 unless identified as “integral” or “provide with VFD” on the schedule. Any disconnects or motor starters listed as “integral” or “provide with VFD” shall be provided as part of the unit by BP-230 and powered up by BP-260.
11. Electrical Contractor will provide and install work required to make the connection from panel to the single point of connection at the Equipment.
12. This Contractor is to provide, install, and connect any electrical whips required for their equipment that is to not receive a hard wired connection from the panel.
13. After removal of existing lighting this package shall provide for temporary electric and lighting throughout until permanent lighting and power is installed.
14. Excludes painting work.
15. Provide and set all roof penetrations as required for roof top Electrical work and make weather tight.
16. Required permits.
17. Sleeves and penetrations.
18. Contractors shall respond to reported system problems within 24 hours and shall make repairs within 48 hours.
   a. Repairs shall be coordinated with and documented to the Construction Manager.
19. Related Layout – This Contractor is responsible for all layouts associated with the installation of their work from existing control points.
20. This package will be responsible for properly securing all devises as required including tie-offs of fixtures and other above ceiling equipment.
21. Provide and install this packages work where required to be embedded into Masonry or other walls. This includes providing and installing all conduits, sleeves, penetrations, etc. as required. Coordinate with Corresponding Contractors as required, includes providing shop drawings, attending preconstruction meetings, etc.
22. Coordinate with other trades all Overhead Rough-In.
23. Remove, store & protect, for reinstallaion as required for all electrical devices as indicated.
24. This contractor will be required to pull permits for all electrical work required; this includes any work that may be performed by owner.
25. This Contractor should reference Equipment Drawings as well as Electrical Drawings and provide the most stringent power requirements. (ie. If Equipment Schedule calls for a 30 amp breaker for a piece of equipment, but an Electrical Panel Schedule calls for 20 amp, then a 30 amp would be required.).
26. This Contractor should coordinate in advance with other trades/owner provide equipment and power requirements for such to ensure proper power is being supplied.
27. Disconnect and Reconnect all Electrical associated with Food Service items in the Kitchen regardless if indicated or not. The intent is to remove these items during construction activities. Visit Site Prior to Bid as necessary to establish full extent of work.
28. Include work required for Electrical items to accommodate the installation of new ceilings. If new Lights, etc. are not called out, then this package shall remove existing, store and reinstall. Take Pictures prior to removal of all items handled by this package.
29. Note: None of the ceilings at LEAD Innovation Studio are scheduled to demo. BP-092 shall
remove the ceiling tile in rooms A100, A101, A103 prior to commencement of work and BP-092 shall reinstall that tile at the completion of the above ceiling work. All ceiling tile outside of these rooms shall be removed and installed by you as required to complete your new Electrical work.

30. Any work that is required to be completed on the fourth floor of the LEAD innovation Center shall be planned to be installed on off hours in coordination with the tenants occupying that floor.

31. Provide power to all motorized projection screens.

32. Provide all work called out by "electrical contractor" on K100, K101 and K102 at PHSHS.

VII. Division 27 – Communications – Complete, the requirements of this section in their entirety, including as drawn, specified and/or reasonably inferred by the documents for all work required under all sections listed in the Table of Contents within this Division. Including but not limited to the items indicated in this package.

1. Provide and install all Raceways, Conduits, Back Boxes, Pull Boxes, etc. necessary for a complete installation of all communications at all new walls at all buildings less Gerner Family Education Center (Gerner) and Prairie Point Elementary (Prairie Point). BP-270 shall provide raceways as needed at all existing walls for communication work as well as ALL Raceways for Gerner and Prairie Point regardless of wall type.

2. At LEAD Innovation Center, provide all devices, equipment, wiring etc. for all Communications, TV, Telephone, etc. as required. At all other buildings, this work shall be completed by BP-270 or by Owner.

3. BP-230 will provide and install all T-Stats work above and beyond the raceways provided by this contractor in new walls. BP-230 will handle any raceways required for existing walls.

VIII. DIVISION 28 - ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION – Complete, the requirements of this section in their entirety, including as drawn, specified and/or reasonably inferred by the documents for all work required under all sections listed in the Table of Contents within this Division. Including but not limited to the items indicated in this package.

1. Provide and install all Raceways, Conduits, Back Boxes, Pull Boxes, Wiring, Devices, equipment, etc. necessary for a complete installation.
   a. Access Control Devices listed in Hardware Specification 087100 will be provided by BP-061 for this package to wire and install. BP-061 will provide pull strings and raceways within their frames/doors for use by this package. Coordinate with BP-061 as required.

2. Provide connections from duct smoke alarms/detectors and fire alarm system.

IX. Other Bid Requirements

1. Alternates – Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.
   a. Alternate #2 – Provide power for Mecho shades at PHSHS. Reference section 122413 for specifications on the shades and Elevation H7/A901 for extent.

2. Unit Prices
   a. (not used)

3. Allowances
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.
   b. Provide a $5,000 Force Allowance for sole use by the Construction Manager. Unused Allowances will be returned to the Owner.

4. Durations – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. Light Fixture Delivery from approved submittals
   c. Overhead Rough-in
d. Wall Rough-in

e. Overhead Trim Out

f. Wall Trim Out

X. Exclusions

a. (not used)

<End of Bid Package 260>
BID PACKAGE 270 - COMMUNICATIONS

Provide all material, labor, equipment, tools, supervision and other items necessary to complete the Communications as required per the contract documents, specifications, drawings, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

I. Division 0 & 1 – Special Provisions, General Conditions, and General Requirements of the Contract.
   1. Provide all work as it relates to this contractor's scope of work per the “General Scope for all Trades” included at the beginning of this specification section.
   2. Contractor must reference the entire set of documents for work that could be required by this scope.
   3. Any references to “areas” within this scope of work shall be the areas as defined by the “Telecommunications Package” and not the Areas called out on the Architectural Drawings, unless specifically noted otherwise.

II. Division 02 – Demolition – Complete as related to the work of this contract.
   1. Section 024119 – Selective Demolition – Complete, including, but not limited to the items listed throughout this bid package.
      a. Demolition and patch-back of walls, slabs and ceilings as required to accommodate Mechanical, Electrical, Plumbing, and/or Fire protection packages (MEPF) as shown on Demo and Architectural Plan(s) will be by others but this package must coordinate with them to minimize over demolition prior to demo.
         i. If demolition and patch-back is required to install this package's work, but is not specifically shown on the Architectural Demo Plan (AD Drawings), then the required demo and patch back shall be provided by this contractor.
         1. Contractor shall reference as-built drawings and/or x-ray prior to trenching, cutting, etc. for any such work.
         2. Where this contractor is responsible for saw cutting, excavating, shoring, backfill & compaction, core drilling, sleeves, penetrations, slab trenching, & debris removal as required for installation of the work associated with this package above and below slab, along with making any penetrations in existing walls and/or where contractor failed to coordinate in advance with new construction in order to accommodate the installation of this packages work.
         3. All patching and repairs required in existing walls, ceiling, floors, concrete etc. that had to be removed to complete the installation of this packages work shall be completed by this package to include patching, painting, caulking, etc. back to like condition and done in a manner so that this package can sell such work to Owner/Architect.
         4. Reinstall (or replace if damaged) all ceiling tiles and grid removed by this package to complete their work.
         5. Protection of surrounding finishes during any cutting/patching made by this package will be the responsibility of this package and shall include all cleanup.
            1. This package shall demo all work associated with the scopes provided by this package inside the building as required. All materials demoed shall be removed to the onsite dumpsters by this package.

III. Division 07 – Thermal and Moisture Protection – Complete as related to the work of this package.
   1. Section 078413 – Penetration Firestopping – Complete including, but not limited to the items listed throughout this bid package.
   2. Section 079200 – Sealants – Complete including, but not limited to the items listed throughout this bid package.
      a. Provide and install Joint Sealants as it pertains to the installation of this contractor's work only.
      b. Provide and install firestopping at all locations where your new work penetrates a rated
assembly.

IV. Division 08 – Openings - Complete as related to the work of this contract.

1. Section 083113 – Access Doors – Complete as related to the work of this contract.
   a. This Contractor is to furnish and install all access panels required for a complete installation of their work.
   b. If access panels are required for this packages work, the size and location must be approved by the A/E prior to installation and after such approval the installation will be this packages responsibility.

V. DIVISION 27 – COMMUNICATIONS – Complete, the requirements of this section in their entirety, including as drawn, specified and/or reasonably inferred by the documents for all work required under all sections listed in the Table of Contents within this Division. Including but not limited to the items indicated in this package.

1. All work shall be installed in accordance with the “Cabled Telecommunications Infrastructure Project Manual” provided within the overall project specifications.
2. BP-260 shall provide and install all Raceways, Conduits, Back Boxes, Pull Boxes, etc. necessary for a complete installation of all communications at all new walls at all buildings less Gerner Family Education Center (Gerner) and Prairie Point Elementary (Prairie Point). BP-270 shall provide raceways as needed at all existing walls for communication work as well as ALL Raceways for Gerner and Prairie Point regardless of wall type.
3. BP-260 shall provide all communications work at at LEAD Innovation Center. No work will be required by this contractor at that location.
4. BP-260 shall provide all conduit runs for communication work at PHSHS. The district shall provide all cabling for Communications at PHSHS. No work for this contractor at that location.
5. BP-270 contractor shall be responsible for removal and reinstallation of any existing ceiling tile and grid that is required to complete your work that is not specifically shown on the drawings as schedule to remove. This contractor shall NOT reinstall ceiling tile in areas where it was removed prior to receiving the Owner’s approval in writing that the Owner has reviewed and approved the new work in place. (This can be schedule by “area” once work is complete and ready for inspection.
6. At Park Hill High School – All work in Areas N & M shall be completed prior to 7/6/18.
7. At Park Hill High School – This contractor shall provide all new communications, intercom, clock work at locations were ceilings and or walls are scheduled to be removed and/or relocated. (ie. Area I)
8. At Park Hill High School - Do not demo any work in areas C,D,F,G,H,I,J,K,L & P. This contractor shall provide all new communications, intercom and clock wiring & termination work as shown in these areas.
9. At Park Hill High School – Demo all existing communication wiring and re-cable areas A,B,M & N. Include all new communications, intercom and clock wiring & termination work as shown in these areas. Also include all new cable tray work for these areas and new work at TR Rooms TR-2 & TR-6 per the specifications.
10. At Gerner Family Early Childhood Center – All work for Areas E&F shall be completed prior to June 29, 2017. Work for Areas C & D cannot be commence until Areas E&F have been turned back over to the District for use. Care must be taken to ensure that Areas A&B (which are fed from the Data Closet in Area C) remain live throughout construction. If it is necessary to take this connection down, it must be completed after hours and coordinated with the district.
11. It should be anticipated that concurrent crews shall be required at each project site. This contract shall also review the full documents to understand that in several locations, communication work will have to be coordinated with other work scheduled to complete and full access to some areas may not be possible throughout the summer renovations.
12. Sleeves and penetrations.
13. Contractors shall respond to reported system problems within 24 hours and shall make repairs within 48 hours.
   a. Repairs shall be coordinated with and documented to the Construction Manager.
14. Related Layout – This Contractor is responsible for all layouts associated with the installation of
their work from existing control points.
15. Coordinate with other trades all Overhead Rough-In.

VI. Other Bid Requirements
1. Alternates
   a. Reference the Alternate Section and Include Alternate Pricing on the Bid Form as it relates to the Work of this Bid Scope that would be required by such alternate.

2. Unit Prices
   a. (not used)

3. Allowances
   a. Provide a composite cleanup allowance of 1/2 % of contract value per section 017419.

4. Durations – Provide the number of working days required for each of the following activities on bid form. Provide separate durations for each locations as applicable.
   a. Submittal Preparation
   b. Material Delivery from approved submittals
   c. Communication work Area A & B – Park Hill High School
   d. Communication work Area M & N – Park Hill High School
   e. Communication work Remaining Areas – Park Hill High School
   f. Communication work Area E & F – Gerner Family Early Childcare Center
   g. Communication work Area C & D – Gerner Family Early Childcare Center
   h. Communication work – Prairie Point Complete

VII. Exclusions
   a. (not used)

<End of Bid Package 270>
DOCUMENT 004200 – PROPOSAL FORM

Bid to
Board of Education
Park Hill – 2018 Summer Renovations
7703 N.W. Barry Road
Kansas City, MO. 64151

Place of Bid Opening
Board of Education
Park Hill District Office
7703 N.W. Barry Road
Kansas City, MO. 64151

Bid For
Park Hill – 2018 Summer Renovations

Time of Bid Opening
March 8, 2018, at 2:00 p.m. (local time) ALL Packages

Construction Manager: Universal Construction Company Inc

BID Package Number: Bid Package Title:
BID Package Number: Bid Package Title:
BID Package Number: Bid Package Title:

Name of Company Bidding:

Address of Bidder:

Telephone Number: Email:

1. THE SITE AND DOCUMENTS

We the undersigned, having examined the Contract Documents, including but not limited to the items listed below and the site of the proposed Work and being familiar with all conditions affecting the construction of the Project, hereby propose and agree to provide and furnish all labor, material, equipment, supervision and other items necessary to perform and complete, in a workmanlike manner, all Work required by the Contract Documents, at the prices stated below. Stated sums include fees, insurance, payroll taxes, and all other charges applicable to materials, appliances, labor and all charges that may be levied. This Bid excludes sales tax.

(a) Instructions to Bidders, AIA Document A701
(b) Supplementary Instructions To Bidders
(c) Subsurface Soils Information
(d) General Conditions of the Contract, AIA Document A232 -2009
(e) Supplementary General Conditions
(f) Specifications
(g) Drawings
(h) Addenda issued during the Time of Bidding
(Numbered , , , , and ).
(i) Scope of Work/Bid Package (by Construction Manager)
(j) Construction Milestone Schedule (by Construction Manager)

In the following proposals, the amounts shall be shown in both words and figures. In case of discrepancy between the word and the figures, the words shall govern. Bidders are advised that Bids not including amounts for the complete work package in which they are bidding may be disqualified. Owner intends to award each Contract to a single Bidder.
2. **THE AMOUNT OF THE BASE BID:**

We propose to furnish all materials and labor called for by the above Documents for the “Total Base Bid” Work for the total sum of:

Dollars and Cents ($ ).

3. **ALTERNATES (IF APPLICABLE):**

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4. **AMOUNTS FOR UNIT PRICES**

We, the undersigned, propose to base adjustments in the Contract Sum, if ordered by the Architect during the Contract Time, on the unit prices listed below. These unit prices constitute full compensation or credit for the complete provision and installation for each item listed based solely on Work in place. The Unit Prices as stated include all necessary appurtenances and connections required to complete the Work in place, insurance, overhead, profit and superintendence. *(List any hourly rates below if requested within your scope of work).*

   | a. Unit Price A: | ($ ) per |
   | b. Unit Price B: | ($ ) per |
   | c. Unit Price C: | ($ ) per |
   | d. Unit Price D: | ($ ) per |
   | e. Unit Price E: | ($ ) per |
   | f. Unit Price F: | ($ ) per |

5. **COMPLETION OF THE WORK**

If we are notified of the acceptance of the Base Bid and alternates of this Proposal within sixty (60) days after the above date, we agree to execute a Contract for the above Work, for the above stated compensation in the form of the Standard Agreement Between Owner and Contractor (Stipulated Sum) AIA Document A101/CMa, of the American Institute of Architects, as modified by the Owner. We further agree to meet the schedule as established by durations provided on Bid Form below and incorporated.
into the Construction Manager’s Construction Schedule and to pay late charges if we fail to meet such schedule. The Undersigned hereby agrees to commence work under the Contract within twenty-four hours after written notice is given that a portion of this Contractor’s work is ready.

6. **BID SECURITY**

Bidders whose Bid includes both labor and materials and whose Base Bid amount is $25,000.00 or greater, agrees to and has attached hereto a Bid Bond for the amount of five percent (5%) of the amount of the Bid submitted.

This Bid Security is to be left in escrow with the Construction Manager. If the Undersigned defaults in executing the Agreement within three (3) days of written notification of the award of the Contract to him, or in furnishing the Performance Bond within fourteen (14) days thereafter, the Bid Security will become the property of the Owner and will be delivered to him by the Construction Manager. If the Undersigned executes and delivers the Agreement and Bond within the time specified, or if the Base Bid of this Proposal is not accepted within sixty (60) days of the time set for submission of Bids, the Bid Security shall be returned to the Contractor upon delivery of a receipt therefore.

If the Undersigned defaults in executing and delivering the above-named Agreement and the required performance Bond, the Owner would sustain liquidated damages for five percent (5%) of the amount of the Bid submitted, the measure of which is the amount of the accompanying bid bond, or cashier’s check, payable to “Joplin School District”.

7. **SCOPE OF WORK DURATIONS**

We, the undersigned, propose the following number of working days to complete the activities listed in the Bid Package Scope of Work.

**Park Hill High School**

Duration 1: _________________ working days  
Duration 2: _________________ working days  
Duration 3: _________________ working days  
Duration 4: _________________ working days  
Duration 5: _________________ working days  
Duration 6: _________________ working days  
Duration 7: _________________ working days  
Duration 8: _________________ working days  
Duration 9: _________________ working days  
Duration 10: _________________ working days

**Park Hill South High School**

Duration 1: _________________ working days  
Duration 2: _________________ working days  
Duration 3: _________________ working days  
Duration 4: _________________ working days  
Duration 5: _________________ working days  
Duration 6: _________________ working days  
Duration 7: _________________ working days  
Duration 8: _________________ working days  
Duration 9: _________________ working days  
Duration 10: _________________ working days

**LEAD Innovation Center**

Duration 1: _________________ working days  
Duration 2: _________________ working days  
Duration 3: _________________ working days  
Duration 4: _________________ working days
Duration 5: _________________ working days
Duration 6: _________________ working days
Duration 7: _________________ working days
Duration 8: _________________ working days
Duration 9: _________________ working days
Duration 10: ________________ working days

Prairie Point Elementary School
Duration 1: _________________ working days
Duration 2: _________________ working days
Duration 3: _________________ working days
Duration 4: _________________ working days
Duration 5: _________________ working days
Duration 6: _________________ working days
Duration 7: _________________ working days
Duration 8: _________________ working days
Duration 9: _________________ working days
Duration 10: ________________ working days

Gerner Family Early Childcare Center
Duration 1: _________________ working days
Duration 2: _________________ working days
Duration 3: _________________ working days
Duration 4: _________________ working days
Duration 5: _________________ working days
Duration 6: _________________ working days
Duration 7: _________________ working days
Duration 8: _________________ working days
Duration 9: _________________ working days
Duration 10: ________________ working days

We, the undersigned, acknowledge and agree that the Owner reserves the right to waive any informality in any Bid and to reject any or all Bids. The undersigned Bidder, on behalf of itself and all sub-bidders, releases the Owner, Architect, Construction Manager and other Bidders from any claim arising out of or relating to the acceptance, non-acceptance, or rejection of the undersigned's or any other Bidder's Bid, including without limitation Bids of its sub-bidders, on this Project.
NOTE: If the Contractor is a Corporation, Proposal must be signed by an authorized officer, showing his title.

Yours very truly,

FIRM: __________________________________________

ADDRESS: ______________________________________

TELEPHONE: ___________________ FAX: ____________

BY: ___________________ TITLE: __________________

STATE OF INCORPORATION: __________________________

FIN: ___________________ or SSN: __________________

Corporate Seal

Notary Seal

Notary Public: __________________________

STATE OF: ___________________ COUNTRY OF: ______

My Commission Expires: ____________________
1.1 Bid Bond
   A. The Form of the Bid Bond shall be the American Institute of Architects Document AIA Document
      A310 “Bid Bond” and is included by reference. Copies may be obtained at cost from the below or
      other means available to bidders:

      Kansas City Chapter
      American Institute of Architects
      104 W. 9th Street
      Kansas City, Missouri 64105
      Telephone: (816) 221-3485.

END OF DOCUMENT
004313
I. Bidders Qualification Statement Form
   A. The Form of the Contractor’s Qualification Statement shall be AIA Document A305, current edition
   B. This form is to be completed and submitted with the proposal form at time of bid opening
   C. Copies may be obtained at cost, from the below location or other means available to bidder
      Kansas City Chapter, American Institute of Architects,
      1801 McGee, Kansas City, Missouri 64108.
      Telephone: (816) 221-3485.

END OF DOCUMENT

004513
1.1 Summary
   A. The Contract will be prepared on AIA Document A132 (CM as advisor), dated 2009, Standard Form of Agreement between Owner and Contractor. A Draft Copy has been attached for reference and it is understand that this draft copy will be modified during issuance of the contract.
AGREEMENT made as of the «  » day of «  » in the year «  »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)
Park Hill School District
7703 NW Barry Road
Kansas City, Missouri 64153
Telephone Number: 816-359-4000

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

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

«17-00153 Park Hill – 2018 Elementary School #11»
«Park Hill High School
7701 NW Barry Road
Kansas City, MO 64153

Park Hill South High School
4500 River Park Drive
Riverside, MO 64150

LEAD Innovation Studio – 5th Floor
10150 N. Ambassador Drive
Kansas City, MO 64153

Prairie Point Elementary
8101 NW Belvidere Parkway
Kansas City, MO 64152

Gerner Family Early Education Center
8100 N Congress Avenue
Kansas City, MO 64152

5520 Northwood Road Kansas City, MO 64151
«Construction Renovations of Above Listed Facilities of New Elementary School #11 »

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

Universal Construction Company, Inc

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.

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

This document is intended to
be used in conjunction with
AIA Documents A232™–2009,
General Conditions of the
Contract for Construction,
Construction Manager as
Adviser Edition; B132™–2009,
Standard Form of Agreement
Between Owner and Architect,
Construction Manager as
Adviser Edition; and
C132™–2009, Standard Form of
Agreement Between Owner and
Construction Manager as
Adviser.

AIA Document A232™–2009 is
adopted in this document by
reference. Do not use with
other general conditions
unless this document is
modified.

ELECTRONIC COPYING of any
portion of this AIA® Document to
another electronic file is
prohibited and constitutes a
violation of copyright laws as
set forth in the footer of this
document.
The Owner and Contractor agree as follows.
TABLE OF ARTICLES

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

EXHIBIT A   DETERMINATION OF THE COST OF THE WORK

ARTICLE 1   THE CONTRACT DOCUMENTS
The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other
Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed
in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are
as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire
and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements,
either written or oral. An enumeration of the Contract Documents, other than Modifications, appears in Article 9.

ARTICLE 2   THE WORK OF THIS CONTRACT
The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in
the Contract Documents to be the responsibility of others.

ARTICLE 3   DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below
or provision is made for the date to be fixed in a notice to proceed issued by the Owner. (Insert the date of commencement, if it differs from the date of this Agreement or, if applicable, state that the date will
be fixed in a notice to proceed.)

«»

If, prior to the commencement of the Work, the Owner requires time to file mortgages, mechanics’ liens and other
security interests, the Owner’s time requirement shall be as follows:

« »

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

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than « »( « ») days from the
date of commencement, or as follows:
(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of
commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the
Work.)

**Substantial Completion Date will be as indicated in the Contract Documents. Contractors will complete their portions
of the work per the durations included in their contract in order to achieve the Project Substantial Completion.**

<table>
<thead>
<tr>
<th>Portion of the Work</th>
<th>Substantial Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>«Contractor agrees to complete portions of their work per their durations in their contract»</td>
<td></td>
</tr>
</tbody>
</table>

, subject to adjustments of this Contract Time as provided in the Contract Documents.

(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for
bonus payments for early completion of the Work.)

**Liquidated Damages of $1,000.00 per Calendar Days as indicated in the Contract Documents and General Conditions.**

**ARTICLE 4  CONTRACT SUM**

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor’s performance of the
Contract. The Contract Sum shall be one of the following:

(Identify the appropriate box.)

[ «X» ] Stipulated Sum, in accordance with Section 4.2 below

[ «» ] Cost of the Work plus the Contractor’s Fee without a Guaranteed Maximum Price, in accordance
with Section 4.3 below

[ «» ] Cost of the Work plus the Contractor’s Fee with a Guaranteed Maximum Price, in accordance with
Section 4.4 below

(Identify the selection above, complete Section 4.2, 4.3 or 4.4 below. Based on the selection above, also complete
either Section 5.1.4, 5.1.5 or 5.1.6 below.)

§ 4.2 Stipulated Sum

§ 4.2.1 The Stipulated Sum shall be «» ($ «» ), subject to additions and deletions as provided in the Contract
Documents.

§ 4.2.2 The Stipulated Sum is based on the following alternates, if any, which are described in the Contract Documents
and are hereby accepted by the Owner:

(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the
Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other
alternates showing the amount for each and the date when that amount expires.)

[ «» ] Unit prices, if any:

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Units and Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>«As listed in Exhibit A Scope of Work»</td>
<td></td>
</tr>
</tbody>
</table>

§ 4.2.4 Allowances included in the Stipulated Sum, if any:

(Identify allowance and state exclusions, if any, from the allowance price.)

([389ADA16])
§ 4.3 Cost of the Work Plus Contractor’s Fee without a Guaranteed Maximum Price

§ 4.3.1 The Contract Sum is the Cost of the Work as defined in Exhibit A, Determination of the Cost of the Work, plus the Contractor’s Fee.

§ 4.3.2 The Contractor’s Fee:
(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor’s Fee.)

§ 4.3.3 The method of adjustment of the Contractor’s Fee for changes in the Work:

§ 4.3.4 Limitations, if any, on a Subcontractor’s overhead and profit for increases in the cost of its portion of the Work:

§ 4.3.5 Rental rates for Contractor-owned equipment shall not exceed ( ) percent ( %) of the standard rate paid at the place of the Project...

§ 4.3.6 Unit prices, if any:
(Identify and state the unit price, state quantity limitations, if any, to which the unit price will be applicable.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Units and Limitations</th>
<th>Price per Unit ($0.00)</th>
</tr>
</thead>
</table>

§ 4.3.7 The Contractor shall prepare and submit to the Construction Manager for the Owner, in writing, a Control Estimate within 14 days of executing this Agreement. The Control Estimate shall include the items in Section A.1 of Exhibit A, Determination of the Cost of the Work...

§ 4.4 Cost of the Work Plus Contractor’s Fee with a Guaranteed Maximum Price

§ 4.4.1 The Contract Sum is the Cost of the Work as defined in Exhibit A, Determination of the Cost of the Work, plus the Contractor’s Fee.

§ 4.4.2 The Contractor’s Fee:
(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor’s Fee.)

§ 4.4.3 The method of adjustment of the Contractor’s Fee for changes in the Work:

§ 4.4.4 Limitations, if any, on a Subcontractor’s overhead and profit for increases in the cost of its portion of the Work:

§ 4.4.5 Rental rates for Contractor-owned equipment shall not exceed ( ) percent ( %) of the standard rate paid at the place of the Project...

§ 4.4.6 Unit prices, if any:
(Identify and state the unit price, state quantity limitations, if any, to which the unit price will be applicable.)

| Item | Units and Limitations | Price per Unit ($0.00) |
§ 4.4.7 Guaranteed Maximum Price

§ 4.4.7.1 The sum of the Cost of the Work and the Contractor’s Fee is guaranteed by the Contractor not to exceed ($ ), subject to additions and deductions by changes in the Work as provided in the Contract Documents. Such maximum sum is referred to in the Contract Documents as the Guaranteed Maximum Price. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the Contractor without reimbursement by the Owner.

(Inset specific provisions if the Contractor is to participate in any savings.)

§ 4.4.7.2 The Guaranteed Maximum Price is based on the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

§ 4.4.7.3 Allowances included in the Guaranteed Maximum Price, if any:

(Identify and state the amounts of any allowances, and state whether they include labor, materials, or both.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

§ 4.4.7.4 Assumptions, if any, on which the Guaranteed Maximum Price is based:

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Construction Manager by the Contractor, and upon certification of the Project Application and Project Certificate for Payment or Application for Payment and Certificate for Payment by the Construction Manager and Architect and issuance by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

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

« »

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

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

§ 5.1.4 Progress Payments Where the Contract Sum is Based on a Stipulated Sum

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

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

§ 5.1.4.3 Subject to the provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

.1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of « » percent ( « »)
%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute may be included as provided in Section 7.3.9 of the General Conditions;

2. Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of \( \text{percent} \times {\text{five}\%} \);

3. Subtract the aggregate of previous payments made by the Owner; and

4. Subtract amounts, if any, for which the Construction Manager or Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of the General Conditions.

§ 5.1.4.4 The progress payment amount determined in accordance with Section 5.1.4.3 shall be further modified under the following circumstances:

1. Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to «ninety five» percent (95\%) of the Contract Sum, less such amounts as the Construction Manager recommends and the Architect determines for incomplete Work and unsettled claims; and

2. Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of the General Conditions.

§ 5.1.5 Reduction or limitation of retainage, if any, shall be as follows:

(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.4.3.1 and 5.1.4.3.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

§ 5.1.5 Progress Payments Where the Contract Sum is Based on the Cost of the Work without a Guaranteed Maximum Price

§ 5.1.5.1 With each Application for Payment, the Contractor shall submit the cost control information required in Exhibit A, Determination of the Cost of the Work, along with payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached and any other evidence required by the Owner, Construction Manager or Architect to demonstrate that disbursements already made by the Contractor on account of the Cost of the Work equal or exceed (1) progress payments already received by the Contractor; less (2) that portion of those payments attributable to the Contractor’s Fee; plus (3) payrolls for the period covered by the present Application for Payment.

§ 5.1.5.2 Applications for Payment shall show the Cost of the Work actually incurred by the Contractor through the end of the period covered by the Application for Payment and for which the Contractor has made or intends to make actual payment prior to the next Application for Payment.

§ 5.1.5.3 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

1. Take the Cost of the Work as described in Exhibit A, Determination of the Cost of the Work;

2. Add the Contractor’s Fee, less retainage of «one percent» percent (1\%). The Contractor’s Fee shall be computed upon the Cost of the Work described in that Section at the rate stated in that Section, or if the Contractor’s Fee is stated as a fixed sum, an amount which bears the same ratio to that fixed sum Fee as the Cost of the Work bears to a reasonable estimate of the probable Cost of the Work upon its completion;

3. Subtract retainage of «one percent» percent (1\%) from that portion of the Work that the Contractor self-performs;

4. Subtract the aggregate of previous payments made by the Owner;

5. Subtract the shortfall, if any, indicated by the Contractor in the documentation required by Article 5 or resulting from errors subsequently discovered by the Owner’s auditors in such documentation; and

6. Subtract amounts, if any, for which the Construction Manager or Architect has withheld or withdrawn a Certificate for Payment as provided in Section 9.5 of AIA Document A232™ – 2009, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition.

§ 5.1.5.4 The Owner, Construction Manager and Contractor shall agree upon (1) a mutually acceptable procedure for review and approval of payments to Subcontractors and (2) the percentage of retainage held on Subcontracts, and the Contractor shall execute subcontracts in accordance with those agreements.
§ 5.1.5.5 In taking action on the Contractor’s Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor and shall not be deemed to represent that the Construction Manager and Architect have made a detailed examination, audit or arithmetic verification of the documentation submitted in accordance with Article 5 or other supporting data; that the Construction Manager and Architect have made exhaustive or continuous on-site inspections; or that the Construction Manager and Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits and verifications, if required by the Owner, will be performed by the Owner’s auditors acting in the sole interest of the Owner.

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

§ 5.1.6 Progress Payments Where the Contract Sum is Based on the Cost of the Work with a Guaranteed Maximum Price

§ 5.1.6.1 With each Application for Payment, the Contractor shall submit payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached, and any other evidence required by the Owner or Architect to demonstrate that each disbursement already made by the Contractor on account of the Cost of the Work equal or exceed (1) progress payments already received by the Contractor; less (2) that portion of those payments attributable to the Contractor’s Fee; plus (3) payrolls for the period covered by the present Application for Payment.

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

§ 5.1.6.3 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment. The percentage of completion shall be the lesser of (1) the percentage of that portion of the Work which has actually been completed; or (2) the percentage obtained by dividing (a) the expense that has actually been incurred by the Contractor on account of that portion of the Work for which the Contractor has made or intends to make actual payment prior to the next Application for Payment by (b) the share of the Guaranteed Maximum Price allocated to that portion of the Work in the schedule of values.

§ 5.1.6.4 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- Take that portion of the Guaranteed Maximum Price properly allocable to completed Work as determined by multiplying the percentage of completion of each portion of the Work by the share of the Guaranteed Maximum Price allocated to that portion of the Work in the schedule of values. Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.10 of AIA Document A232–2009;
- Add that portion of the Guaranteed Maximum Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work, or if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing;
- Add the Contractor’s Fee, less retainage of 1 percent (1%). The Contractor’s Fee shall be computed upon the Cost of the Work at the rate stated in Section 4.4.2 or, if the Contractor’s Fee is stated as a fixed sum in that Section, shall be an amount that bears the same ratio to that fixed-sum fee as the Cost of the Work bears to a reasonable estimate of the probable Cost of the Work upon its completion;
- Subtract retainage of 1 percent (1%) from that portion of the Work that the Contractor self-performs;
- Subtract the aggregate of previous payments made by the Owner;
- Subtract the shortfall, if any, indicated by the Contractor in the documentation required by Section 5.1.6.1 to substantiate prior Applications for Payment, or resulting from errors subsequently discovered by the Owner’s auditors in such documentation; and
- Subtract amounts, if any, for which the Construction Manager or Architect have withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A232–2009.
§ 5.1.6.5 The Owner and the Contractor shall agree upon a (1) mutually acceptable procedure for review and approval of payments to Subcontractors and (2) the percentage of retainage held on Subcontracts, and the Contractor shall execute subcontracts in accordance with those agreements.

§ 5.1.6.6 In taking action on the Contractor’s Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor and shall not be deemed to represent that the Construction Manager or Architect have made a detailed examination, audit or arithmetic verification of the documentation submitted in accordance with Section 5.1.6.1 or other supporting data; that the Construction Manager or Architect have made exhaustive or continuous on-site inspections; or that the Construction Manager or Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits and verifications, if required by the Owner, will be performed by the Owner’s auditors acting in the sole interest of the Owner.

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

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

.1 the Contractor has fully performed the Contract except for the Contractor’s responsibility to correct Work as provided in Section 12.2 of AIA Document A232–2009, and to satisfy other requirements, if any, which extend beyond final payment;

.2 the Contractor has submitted a final accounting for the Cost of the Work, pursuant to Exhibit A, Determination of the Cost of the Work when payment is on the basis of the Cost of the Work, with or without a Guaranteed Maximum payment; and

.3 a final Certificate for Payment or Project Certificate for Payment has been issued by the Architect; such final payment shall be made by the Owner not more than 30 days after the issuance of the final Certificate for Payment or Project Certificate for Payment, or as follows:

ARTICLE 6 DISPUTE RESOLUTION
§ 6.1 Initial Decision Maker
The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A232–2009, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution
For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A232–2009, the method of binding dispute resolution shall be as follows:
(Enter either the appropriate box under 6.2.2, or if the Owner and Contractor do not select a method of binding dispute resolution above, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

[ «X» ] Litigation in a court of competent jurisdiction.
[ « » ] Other: (Specify)
ARTICLE 7   TERMINATION OR SUSPENSION

§ 7.1 Where the Contract Sum is a Stipulated Sum

§ 7.1.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2009.

§ 7.1.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2009.

§ 7.2 Where the Contract Sum is Based on the Cost of the Work with or without a Guaranteed Maximum Price

§ 7.2.1 Subject to the provisions of Section 7.2.2 below, the Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2009.

§ 7.2.2 The Contract may be terminated by the Owner for cause as provided in Article 14 of AIA Document A232–2009; however, the Owner shall then only pay the Contractor an amount calculated as follows:

1. Take the Cost of the Work incurred by the Contractor to the date of termination;

2. Add the Contractor’s Fee computed upon the Cost of the Work to the date of termination at the rate stated in Sections 4.3.2 or 4.4.2, as applicable, or, if the Contractor’s Fee is stated as a fixed sum, an amount that bears the same ratio to that fixed sum Fee as the Cost of the Work at the time of termination bears to a reasonable estimate of the probable Cost of the Work upon its completion; and

3. Subtract the aggregate of previous payments made by the Owner.

§ 7.2.3 If the Owner terminates the Contract for cause when the Contract Sum is based on the Cost of the Work with a Guaranteed Maximum Price, and as provided in Article 14 of AIA Document A232–2009, the amount, if any, to be paid to the Contractor under Section 14.2.4 of AIA Document A232–2009 shall not cause the Guaranteed Maximum Price to be exceeded, nor shall it exceed the amount calculated in Section 7.2.2.

§ 7.2.4 The Owner shall also pay the Contractor fair compensation, either by purchase or rental at the election of the Owner, for any equipment owned by the Contractor that the Owner elects to retain and that is not otherwise included in the Cost of the Work under Section 7.2.1. To the extent that the Owner elects to take legal assignment of subcontracts and purchase orders (including rental agreements), the Contractor shall, as a condition of receiving the payments referred to in this Article 7, execute and deliver all such papers and take all such steps, including the legal assignment of such subcontracts and other contractual rights of the Contractor, as the Owner may require for the purpose of fully vesting in the Owner the rights and benefits of the Contractor under such subcontracts or purchase orders.

§ 7.2.5 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2009; in such case, the Contract Sum and Contract Time shall be increased as provided in Section 14.3.2 of AIA Document A232–2009, except that the term ‘profit’ shall be understood to mean the Contractor’s Fee as described in Sections 4.3.2 and 4.4.2 of this Agreement.

ARTICLE 8   MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A232–2009 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located. (Insert rate of interest agreed upon, if any.)

« % »

§ 8.3 The Owner’s representative:
(Name, address and other information)

«Jim Rich»
§ 8.4 The Contractor’s representative:

(Name, address and other information)

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

§ 8.6 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A132–2009, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition.


§ 9.1.3 The Supplementary and other Conditions of the Contract:

<table>
<thead>
<tr>
<th>Document</th>
<th>Title</th>
<th>Date</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>As listed in the Exhibit B attached hereto</td>
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</table>

§ 9.1.4 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Date</th>
<th>Pages</th>
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§ 9.1.5 The Drawings:

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
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§ 9.1.6 The Addenda, if any:

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<td>As listed in the Exhibit B attached hereto</td>
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Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents are:
2. AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed, or the following:
   3. AIA Document E202™–2008, Building Information Modeling Protocol Exhibit, if completed, or the following:
   4. Other documents, if any, listed below:

   (List here any additional documents which are intended to form part of the Contract Documents. AIA Document A232–2009 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor’s bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

   Exhibit A Scope of Work
   Exhibit B Specifications, Drawings, Addendum
   Exhibit C Durations
   Exhibit D Prevailing Wage Clarifications
   Exhibit E Certified Payroll Form
   Exhibit F Schedule of Values Template

ARTICLE 10   INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A232–2009.

(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A232–2009.)

<table>
<thead>
<tr>
<th>Type of Insurance or Bond</th>
<th>Limit of Liability or Bond Amount ($0.00)</th>
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<tbody>
<tr>
<td>1. Payment and Performance Bond for 100% of the of the Contract as indicated in the Contract Documents and General Conditions</td>
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<tr>
<td>2. Insurance Requirements as indicated in the Contract Documents and General Conditions</td>
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This Agreement is entered into as of the day and year first written above.

« »
OWNER (Signature)

« >> «»
(Printed name and title)

« »
CONTRACTOR (Signature)

« >> «»
(Printed name and title)
1.1 Performance Bond and Payment Bond
   A. The Forms of the Performance Bond and Payment Bond shall be AIA Document A312, current
      edition, or similar document approved by the Owner and Construction Manager.
   B. Contractor is responsible for procurement of forms.

1.2 Modifications to Performance Bond
   A. The Performance Bond AIA Document A312, current edition, shall be written for one hundred
      percent (100%) of the Contract Sum and shall be modified to additionally require the prompt and
      faithful performance of any and all guarantees, warranties, required by the Contract for a period
      of one (1) year after final payment for the Work is due. Such limitation as to the sureties’
      obligation shall not reduce the obligation of the Contractor under or through the Contract.

1.3 Modifications to Payment Bond
   A. The Payment Bond, AIA Document A312, current edition, shall be written for one hundred
      percent (100%) of the Contract Sum.

END OF DOCUMENT
006113
1.1 Application and Certification for Payment  
   A. The Form of the Application and Certificate for Payment shall be on an AIA Documents G732 and G703, current edition or a similar document as approved by the Construction Manager.  
   B. Instructions for submitting Application for Payment can be found in other sections of the contract documents.
1.1 Partial Lien Waiver
   A. The Form of the Partial Lien Waiver is bound hereinafter for Contractor's use and duplication.
PARTIAL LIEN WAIVER

TO: Park Hill School District Board of Education - 7703 N.W. Barry Road, Kansas City, Missouri 64153

Contractor: ________________________________________________________________

Address: ________________________________________________________________

PROJECT: ________________________________________________________________

BID PACKAGE: ___________________________________________________________

PERIOD TO: _____________________________________________________________

Amount of Previous Payments: _____________________________________________

Amount of Current Payment Due: ___________________________________________

I hereby certify that the work performed, and the materials supplied to date represent the actual value of accomplishment under the terms of the Contract (and all authorized changes thereto) between the undersigned and Park Hill School District, Kansas City, Missouri relating to the above referenced project.

I also certify that payments, less applicable retention, have been made through the period covered by previous payments received from the Contractor, to (1) all my subcontractors (subcontractors) and (2) for all materials and labor used in or in connection with the performance of the Contract. I further certify I have complied with Federal, State and local tax laws, including Social Security, Unemployment Compensation, and Workmen’s Compensation laws as applicable to the performance of the Contract.

Furthermore in consideration of the payments received, the undersigned does hereby waive, release and relinquish all claim or rights which the undersigned may now have upon the premises except for claims or right of lien for contract and/or change order work performed to extent that payment is being retained or will subsequently become due.

Date: ______________________

Name: ______________________________________________________________________

Signature: ___________________________________________________________________

Title: _______________________________________________________________________

Subscribed and sworn before me this ____________ day of ________________

Notary Public: __________________________________________________________________

My Commission Expires: __________________________________________________________________

Seal: _______________________________________________________________________

Park Hill School District PARTIAL LIEN WAIVER 006275 - 2
Project No: 16111, 17088, 17097, 17115
February 18
1.1 Bailment Receipt
   A. The Form of the Bailment Receipt is bound hereinafter for Contractor's use and duplication.
**NON-NEGOTIABLE BAILMENT RECEIPT**

**BAILOR:** Park Hill School District  
7703 N.W. Barry Road  
Kansas City, Missouri 64153

**BAILEE:**  
Contractor/Supplier

**PROJECT:**  

**LOCATION OF STORAGE:**  

The goods and materials described below are held and stored pursuant to the Contract by and between Bailee, as Contractor/Supplier, and the Bailor as Owner, for Work to be performed at the above referenced Project location. Said goods and materials are to be transferred or delivered to the Project site in conjunction with the performance of Bailee’s Contract referenced above or upon the direction of Bailor or its Construction Manager and no other. The Bailee acknowledges that it has no ownership rights or title in, nor shall claim any lien or interest in or upon, said goods and materials.

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Receipted and Acknowledged  
Contractor/Supplier

DATED: ______________________  
By: ______________________
1.1 Bill of Sale
   A. The Form of the Bill of Sale is bound hereinafter for Contractor's use and duplication.
BILL OF SALE

SELLER: ____________________________________________________, Subcontractor or Supplier

Address: _____________________________________________________________________________

In consideration of payments made pursuant to its Contract, Park Hill School District of Kansas City, Missouri as Owner, Buyer, dated _________ for the Project known as __________________________ receipt of which is hereby acknowledged, Seller does hereby grant, sell, transfer, and deliver to Buyer right, title and interest in the following goods: ________________________________________________________
________________________________________________________________________________________
________________________________________________________________________________________

Buyer shall have all rights and title to the goods in himself and his executors, administrators and assigns. Seller is the lawful owner of the goods and the goods are free from all encumbrances. Seller has good right to sell the goods and will warrant and defend the right against the lawful claims and demands of all persons. It is expressly understood and agreed that the acceptance of the goods described herein is not a waiver of any right of action that the Buyer may have for breach of warranty of any other cause under the Contract referenced above or at law. In Witness Whereof, Seller has executed this Agreement the __________________ day of _________________, __________________.

Seller: ____________________________________________________________(subcontractor,supplier)

By: __________________________________________________________________________

Title: __________________________________________________________________________

ASSIGNMENT OF BILL OF SALE

____________________________________________________________________, in consideration of payments made by __________________________ (Owner), pursuant to its Contract dated _____________, ____________ 20__ for the Project known as __________________________ does hereby assign this Bill of Sale to Owner.

Signed:

By: __________________________________________________________________________

Title: __________________________________________________________________________

Date: __________________________________________________________________________
1.1 Applicable Conditions
DOCUMENT 007300- SUPPLEMENTARY CONDITIONS

The following Supplements hereby amend and modify the General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, AIA Document A232-2009 Edition. In the event of any conflict, inconsistency, or ambiguity between the terms and provisions of these Supplemental Conditions and those of the AIA Document A232-2009, these Supplemental Conditions shall govern and Control.

ARTICLE 1- CONTRACT DOCUMENTS

REVISE Subparagraph 1.1.1 as follows:

DELETE the last sentence in its entirety and in lieu thereof, add the following: “The Contract Documents will also include Bidding Documents (including, but not limited to, the Advertisement or Invitation to Bid, Instruction to Bidders, Supplementary Instructions to Bidders and Addenda or portions of addenda relating to any Bidding Documents).

REVISE Subparagraph 1.2.1 as follows:

At the end of the paragraph ADD the following:

“Whenever Contract Documents reasonably infer materials or installation as necessary to produce the intended results, but do not fully detail or specify such materials, the Contractor shall provide the materials and labor required for installation. Should a conflict occur between the Drawings and Specification, the Contractor shall provide the more expensive method or material unless he has obtained a written decision from the Architect prior to submitting his Bid”

ADD new Subparagraph 1.2.4 through 1.2.11:

“1.2.4 Scope paragraphs placed at the beginning of the Sections present a brief indication of the principal Work included in that Section, but do not limit Work to subject mentioned nor purport to itemize Work that may be included.”

“1.2.5 The Relation of Specifications and Drawings shall be equal authority and priority. Should they disagree in themselves, or with each other, bids shall be based on the most expensive combination of quality and quantity of work indicated. The appropriate Work in the event of the above-mentioned disagreements shall be determined by the Architect.”

“1.2.6 Should the Drawings disagree themselves, figures shall govern over scaled measurements, large scale Drawings shall govern over small scale Drawings, the greater quantity of work or materials shall be furnished and performed; the descriptive writings shall govern over legends indicating material or conditions and the Agreement takes precedence over all other Contract Documents.”

“1.2.7 Failure to report a conflict in the Contract documents shall be deemed evidence that the Contractor has elected to proceed in the more expensive manner.”

“1.2.8 The Specifications have been partially ‘streamlined’ and some words and phrases have been intentionally omitted. Missing portions shall be supplied by inference as with notes on drawings.”

“1.2.9 The words ‘approved’, ‘inspected’, ‘directed’, ‘selected’, and similar words and phrases shall be presumed to be followed by ‘by Architect/Engineer’. The words ‘satisfactory’, ‘submitted’, ‘reported’, and similar words and
phrases shall be presumed to be followed by 'by Architect/Engineer'. Words like 'install', 'provide', 'locate', 'furnish', and 'supply', shall be construed to include complete furnishings and installing or construction."

"1.2.11 Instructions, directions and requirements as specified shall be considered to be followed by the phrase 'unless otherwise specified or indicated'."

"1.2.12 A color (:) following a material or item shall be used in place of the words, 'shall be'."

ADD new Subparagraph 1.4.1:

"1.4.1 The term 'provide' means 'Contractor shall furnish all labor, materials, equipment and installation'."

ARTICLE 2 - OWNER
DELETE Article 2.1.2 in its entirety.
DELETE Subparagraph 2.2.5 and in lieu thereof ADD the following:

"2.2.5 Contractors will be responsible for their own procurement of complete hard sets of construction documents for field and office use.

REVISE Paragraph 2.4 as follows:

Reference in this Paragraph in line two, are hereby changes from "a ten-day period" to "forty-eight hours".

ARTICLE 3 - CONTRACTOR
DELETE Subparagraph 3.3.1 and in lieu thereof ADD the following:

"3.3.1 The responsibility of the construction means, methods and techniques, shall be the responsibility of each Contractor. Sequence shall be agreed upon between the Construction Manager/Owner and the Contractor prior to all operations for the purpose of scheduling all Contractors on the job."

ADD new Clause 3.4.2.1 as follows:

"3.4.2.1 After the contract has been executed, the Owner and the Architect will consider a formal request for the substitution of products in place of those specified only under the conditions set forth in the General Requirements (Division 1 of these Specifications)."

ADD new Subparagraph 3.5.1 as follows:

"3.5.1 The Contractor shall secure warranties and guarantees and deliver copies of same to the Owner upon completion of Work."

ADD new Subparagraph 3.6.1 as follows:

"3.6.1 Pursuant to the Owner’s Missouri Tax Exemption status, all purchases of materials and equipment incorporated in this Project shall be exempt from Sales Tax."

ADD new Clause 3.10.1.1 as follows:
A detailed time line schedule shall be submitted within fifteen (15) days after award of the Contract. Schedule shall include anticipated labor/crew size, manpower, activity durations. Schedule information shall include shop drawing submittal schedule, material delivery schedule and construction activity information. Submit update of schedule with each request for payment. Pay requests will not be processed without updated schedule.”

ARTICLE 4 – ARCHITECT AND CONSTRUCTION

ADD Clause 4.2.4.1 as follows:

“4.2.4.1 Contractor shall make any revisions to the Construction Schedule deemed necessary by the Construction Manager after a joint review.”

ARTICLE 7 – CHANGES IN THE WORKTIME

ADD Clause 7.3.7.6 as follows:

“7.3.7.6 In Subparagraph 7.3.7 the allowance for the combined overhead and profit included in the total cost to the Owner shall be based on the following schedule:

1. For the Contractor, for Work performed by the Contractors own forces, ten (10) percent of the cost.

2. For the Contractor, for Work performed by the Contractors Subcontractors, five (5) percent of the amount due the Subcontractor.

3. Cost to switch overhead and profit is to be applied shall be determined in accordance with Subparagraph. 7.3.7.

4. In order to facilitate checking of quotations for extras or credits, all proposals shall be accompanied by a complete itemization of costs including labor, materials and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change be approved without such itemization. If Contractor fails to provide itemized breakdown as described to the Construction Manager/Owner within 45 days after request the Contractor will waive all rights for additional costs for the work.”

ARTICLE 8 - TIME

ADD to Subparagraph 8.1.3:

The Contract Time is hereby defined as the number of calendar days set forth in the Agreement Between the Owner and Contractor, (between Notice to Proceed and Date of Substantial Completion). It is necessary that the Project (Base Bid and all accepted Alternates) be completed no later than the working days included in your contract for each or any of the specific durations requested in your scope or work. The Contractor (and his Surety) agrees to a payment of One Thousand Dollars ($1,000.00) per day by the Contractor to the Owner for every calendar day that the Project is not completed beyond the Contract Time until the Work is Substantially Completed. The work shall not be deemed to be Substantially Complete until the contractor receives confirmation in writing from the CM that the activity in question is substantially complete.
ADD the following new Subparagraph 8.15:

“8.1.5 The term Working Day as used in Contract Documents for extensions of time shall mean normal working day excluding weekends and legal holidays.”

REVISE Subparagraph 8.3.1 as follows:

DELETE the words “unusual delay in deliveries, unavoidable casualties” from the third and fourth lines and after the word control in line four, DELETE the balance of the language in this Subparagraph and ADD the following in its place: “or by other occurrences which the Architect, based on the recommendation of the Construction Manager and subject to the Owner’s approval, determines to justify, then, provided that the Contractor is in compliance with Subparagraph 15.1.2 “Notice of Claims” hereof, the Contract Time shall be extended by Change Order for the length of time actually and directly caused by such occurrence as determined by the Architect and approved by the Contractor and Owner (such approval not to be unreasonably withheld, delayed, or conditioned): provided, however, that such extension of Contract Time shall be net of any delays caused by or due to the fault or negligence of the Contractor or which are otherwise the responsibility of the Contractor. The Contractor shall, in the event of any occurrence likely to cause a delay, cooperate in good faith with the Architect, Construction Manager and Owner to minimize and mitigate the impact of any such occurrence and do all things reasonable under the circumstances to achieve this goal.”

REVISE Subparagraph 8.3.2 to read as follows:

“8.3.2 All claims for extensions of time shall be made in writing (stating dates and causes) to the Architect each month and shall accompany the Application for Payment; otherwise, they shall be waived. In this case of continuing cause of delay, only one claim is necessary.”

ARTICLE 9 - PAYMENTS AND COMPLETION

ADD new Subparagraph 9.2.2 through 9.2.5 as follows:

“9.2.2 Each Contractor will submit to the Construction Manager, a Schedule of Values that includes all major categories of work. For each major category of work, the Contractor shall provide a description of the work and the corresponding total installed value of that work item. The sum of the totals for each of the major components shall equal the Contractor’s Bid amount for the Project.” The Construction Manager will compile and submit to the Architect, four (4) originals of the Schedule of Values.”

“9.2.3 Each Contractor shall submit this information typed on Schedule AIA Form G703 Application and Certificate for Payment Continuation Sheet. Contractor’s Standard Form or electronic media printout will be considered as an alternative for meeting this requirement. Contractor’s shall submit a completed Schedule of Values no later than the time at which the executed copy of the Contract is submitted to the Construction Manager in accordance with the Contract Documents.”
“9.2.4 The Schedule of Values must be received and approved by the Construction Manager before the first Application for Payment will be processed.”

“9.2.5 Add to the Schedule of Values approved Change Orders, with each Application for Payment. List Change Orders in numerical sequence. The approved Schedule of Values is to be used by Contractors on their Application for Payment.”

9.3 Application for Payment

DELETE Sub-subparagraph 9.3.1.1 in its entirety and in its place, substitute the following:

“9.3.1.1 No payments will be made for any work performed by the Contractor that has not been included into an approved Change Order.”

ADD the following new Sub-subparagraph 9.3.1.3 as follows:

“9.3.1.3 Until Final Acceptance as set forth in Division 1 Section, the Owner shall ninety (90) percent of the Amount due to the Contractor on account of progress payments.

ADD the following new Subparagraphs:

“9.3.4 Applications for Payment shall reflect retainage in an amount equal to ten percent (5%) of the requested payment. No amounts held by Owner as retainage hereunder shall be paid to the Contractor until the Architect has approved final payment to such Contractor.”

“9.3.5 Each Contractor will submit to the Construction Manager, on forms provided by the Construction Manager, along with his pay applications commencing with Application Number Two (2) a Contractor’s Affidavit and Waiver of Lien that all labor and materials invoices have been paid through the previous applications. Each Contractor is required to provide, with each request for payment, lien waivers from Contractor for the amount presently requested and from all subcontractors and material men for work done and materials, equipment and fixtures furnished through the date covered by the previous payment. Concurrently with the final payment, the Owner shall require the Contractor to execute a waiver or release of lien for all work performed and materials furnished hereunder, and shall require the Contractor to obtain similar waivers or releases from all subcontractors, sub subcontractors and material men. Said waivers shall be in the form as provided in the Contract Documents.”

“9.3.6 Application for Progress Payments: In accordance with the Contract Documents for each calendar month during the progress of the Work, the Contractors shall submit a fully itemized, notarized Application for Payment. Applications for Payment must be received by the Construction Manager no later than the twenty-fifth (25th) of the month for submittal to the Architect no later than the first day of the following month and subsequent submittal to the Owner by the tenth (10th) of the month. Payment to the Contractor by the Owner will be made within thirty (30) days of receipt by the Owner.”

“9.3.7 The form to be used for the Application for Payment is to be the AIA Document G732 - 2009 Edition. This form must be completely filled out and supported by the Schedule of Values completed as described above on AIA Form G703 or similar...
approved Contractor’s substitute. For any item in the Schedule of Values contained in Document G703 that contain amounts in the “materials presently stored” column, the Contractor must submit supporting documentation in the form of Vendor invoices or “stock tickets” to support the amount so claimed in the stored materials column. Each Progress Payment package submitted on a monthly basis shall contain the following:


“9.3.7.2 Continuation Sheet, AIA Document G703.”

“9.3.7.3 Contractor’s Partial Lien Waiver.”

“9.3.7.4 Affidavit of Compliance with Prevailing Wage law. Where stored material appears on the current Application for payment, Supporting documentation for the stored materials (i.e., Vendor invoices, shop tickets, etc., etc.) Contractors must submit a fully executed Bailment Receipt when requesting payment for materials properly stored off-site.

When the Construction Manager finds the Application package properly completed and correct, he will transmit the Certificates for Payment to the Architect to be certified for payment.”

“9.3.8 Application for Final Payment: Submit the final Application for Payment following the same procedure specified above for Progress Payments.

Before submitting Final Application for Payment, forward to the Construction Manager for submittal to the Owner and Architect, the written warranties and guarantees, record and information manuals, and other documents required by the Contract Documents, and place properly in approved storage at the site the extra stock and spare parts specified. Contractor will obtain the signature of the Construction Manager verifying receipt of the extra stock and spare parts.”

9.8 Substantial Completion

ADD the following Subparagraph:

“9.8.1.1 Each Contractor shall carefully and regularly check his Work for conformance with the Contract Documents as the Work is being done. Unsatisfactory Work shall be corrected as the Work progresses and not be permitted to remain and become a part of the Punch List. When the Contractor determines that the entire Work is ready for the Punch List inspection, he shall so notify the Construction Manager, who shall make arrangements with the Architect for the Punch List inspection at the earliest possible date. Transmittal of the Punch List to the Contractor shall set the date for a re-inspection prior to issuance of a Certificate of Substantial Completion. Upon receipt of the Punch List, the Contractor shall within seven (7) days bring to the attention of the Construction Manager any questions that he may have concerning requirements of the Punch List.

When advised by the Contractor that all items on the Punch List have been completed and/or corrected, the Construction Manager shall make arrangements with the Architect for a re-inspection and shall be accompanied by the Contractor and any needed Subcontractors to determine whether the Certificate of Substantial Completion can be issued. When issued, the Certificate of Substantial Completion shall state the date of commencement of the Warranty
period (with any items to have a later starting date specifically noted). The Certificate shall also have attached to it the uncompleted Punch List items, and shall name the date for their completion. The Certificate of Substantial Completion shall also state the responsibilities of the Owner and the Contractor for maintenance, heat, utilities, insurance and building security. Acknowledgment of the Date of Substantial Completion by the signature of all parties on the Certificate implies possession of the premises by the Owner, and future completion of incomplete Punch List items by the Contractor and the Subcontractors at the Owner’s convenience. The Owner shall cooperate in permitting the Contractor access to the Work for the completion of the Punch List items.

Contractors shall also submit Final Lien Waiver and Release along with Contractor’s Affidavit in duplicate prior to the final payment.

Final Payment shall be accompanied by a properly executed “Consent of Surety”, AIA Document G707, Current Edition.”

9.11 Liquidated Damages

9.11.1 The Contractor and the Contractor’s Surety, if any, shall be liable for and shall pay the Owner the sums hereinafter stipulated as Liquidated Damages for each calendar day of delay after the date established for Substantial Completion in the Contract Documents until the Work is Substantially Complete: One Thousand Dollars ($1,000.00), refer to Article 8 of this Section.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

ADD the following new Subparagraphs:

10.1.1 Contractors shall provide the Construction Manager with complete copies of all accident reports within 24 hours of incident.

10.1.2 Contractors shall hold weekly job site safety meetings and minutes of such meetings are to be filed with Construction Manager weekly.

10.1.3 Contractors shall develop a written emergency safety plan to be kept on file with the Construction Manager.

ARTICLE 11 - INSURANCE AND BONDS

“ADD to Subparagraph 11.1.1 and 11.1.2:

11.1.1 In the first line after the word “from”, ADD the following: ... an insurance carrier licensed to do business in the state of Missouri; carries a Best’s policyholder rating of “A” or better and carrier at least a Class “X” financial rating.” In the second line, after the word “Contractor”, ADD the following: ... “Owner, all of it’s officers, directors and employees and Architect.” In the fifth line after the word “them”, ADD the following ”... Contractor shall either cover all Subcontractors or require each Subcontractor not so covered to secure insurance in the minimum amounts required by the Contractor:

11.1.2 The following minimum insurance coverage’s are required:
COVERAGES COMPENSATION

a. General Liability (Occur)  
   General Aggregate    $2,000,000  
   Products-Comp/Op Agg  $2,000,000  
   Personal & Adv Injury  $1,000,000  
   Each Occurrence       $1,000,000  
   Fire Damage (any one fire) $50,000  
   Med Exp (Any one person) $5,000

b. AUTOMOBILE LIABILITY  
   Any Auto, Hired Auto, Non-Owned Auto  
   Combined Single Limit  $1,000,000

c. Excess Liability (Umbrella Form)  
   Each Accident  $2,000,000

d. Worker’s Compensation & Employer’s Liability  
   Each Accident  
   Disease-Policy Limit  $500,000  
   Disease Each Employee $500,000

e. SPECIAL HAZARDS  
   The Contractor must furnish evidence of insurance for the special hazards of blasting  
   or explosion, collapse, and underground damage.

f. INDEMNIFICATION  
   The Certificates of Insurance required under Subparagraph 11.1.3 shall show  
   inclusion of the contractual liability as required under Paragraph 3.18. The  
   Owner, all of its officers, directors and employees and the Architect, and the  
   Architect’s Consultants shall be named as additional insured’s in Contractor’s  
   Liability Insurance Coverage.

g. CANCELLATION OF POLICY  
   All insurance policies shall provide that no cancellations of the policy or endorsement  
   shall be effective until the Owner, the Construction Manager and the Architect have  
   received 30 day prior written notice for cancellation and expiration of insurance as  
   evidence by return receipts of registered or certified letter.”

“In Paragraph 11.1.2, REVISE the third line as follows; after the word “occurrence: DELETE ... or  
claims-made...”

ADD new Clauses:

“11.1.2.1 If for any reason, the Contractor fails to obtain or maintain the required insurance, the  
Owner, at his option, may obtain said insurance or any part thereof, and charge the  
cost against any money due or otherwise due the Contractor.”

“11.1.2.2 ADD the following Paragraph:

“For purposes of identification in the Contract Documents, as required, the  
deductible for the insurance coverage shall be in the amount of $1,000.00.”

11.2  OWNER’S LIABILITY INSURANCE
DELETE Paragraph 11.2 and SUBSTITUTE the following:

"11.2  As to any policies of insurance wherein the parties described in Article 11.1.3 cannot be named as additional insureds, each Contractor shall furnish and maintain during the life of the Contract, Owner’s Protective (Bodily Injury and Property Damage) Liability Insurance in the same Company providing the policy of comprehensive General Liability, naming such parties as insureds, providing for a limit of not less than $1,000,000.00 for all damages arising out of bodily injury to or the death of one person, and not less than $1,000,000.00 for all damages arising out of injury to or the death of two or more persons in any one occurrence, and not less than $1,000.00 for all damages arising out of injury to destruction of property in any one occurrence."

11.3 PROPERTY INSURANCE

Add the following sentence to Subparagraph 11.1.3:

If this insurance is written on a Commercial General Liability policy form, the certificates shall be ISO Occurrence Form CG 00 01 07 98 or later edition completed and supplemented in accordance with AIA Document G715, Instruction Sheet and Supplemental Attachment for ACORD Certificate of Insurance 25-S.

Add the following sentence to Clause 11.3.1.3:

This property insurance is written with a deductible of $1,000.00 per occurrence

Add the following Clause 11.3.1.6:

11.3.1.6 The insurance required by paragraph 11.3 is not intended to cover machinery, tools and equipment owned or rented by the Contractor that are utilized in the performance of the Work but not incorporated into the permanent improvements. The Contractor shall, at the Contractor's own expense, provide insurance coverage for owned or rented machinery, tools and equipment, which shall be subject to the provisions of Subparagraph 11.3.7.

ADD Clause 11.4.1.1 as follows:

"11.4.1.1 Contractors shall furnish a Surety Bond in an amount at least equal to one hundred percent (100%) of his Contract covering the faithful performance of the Contract and for the payment of all obligations in connection with said Contract. Such Bond shall include any guarantee or warranty provided in said Contract. Surety Company providing Bid, Payment and Performance must be listed in the latest edition of the Federal Register as holding a certificate of authority and an underwriting limit large enough for the project. The Surety must also be licensed to do business in the State of Missouri. Park Hill School District shall be named as obligee."

ARTICLE 15- CLAIMS AND DISPUTES

DELETE Clause 15.1.5.2 and REPLACE with the following:

"15.1.5.2 Any claim for extension of time shall be made in writing to the Construction Manager not more than seven (7) days after commencement of the delay, otherwise, it shall be waived. In case of a continuing delay only one claim is necessary. In case of claims for extensions of time because of adverse weather, such extensions of time shall be granted only when such adverse weather prevented the execution of major items of Work as defined in Paragraph 8.3.3 on normal working days and exceeds the number of anticipated days. The following are considered reasonable anticipated days of adverse weather on a monthly..."
basis and shall be included in the contract time.

<table>
<thead>
<tr>
<th>Month</th>
<th>Days</th>
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</thead>
<tbody>
<tr>
<td>January</td>
<td>10</td>
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<td>February</td>
<td>9</td>
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<td>March</td>
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<td>April</td>
<td>6</td>
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<td>May</td>
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<td>June</td>
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<td>July</td>
<td>5</td>
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<td>August</td>
<td>3</td>
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<tr>
<td>September</td>
<td>6</td>
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<td>October</td>
<td>4</td>
</tr>
<tr>
<td>November</td>
<td>6</td>
</tr>
<tr>
<td>December</td>
<td>7</td>
</tr>
</tbody>
</table>

Adverse weather days beyond the total allotted yearly number (71) will be allowed to extend contract time, only if approved and authorized by the Architect, the Construction Manager and the Owner.

15.1.5.3 An adverse weather day is defined as a day where at least four (4) hours of work on a principal unit of work (critical path) underway, between the hours of 7:00 a.m. and 6:00 p.m. cannot be completed because of weather conditions beyond control of the Contractor.

ADD new Article 16 as follows:

ARTICLE 16 - ADDITIONAL PROVISIONS

16.1 Tax Exemptions

16.1.1 It is the Owner’s intent to take advantage of their tax-exempt status. Therefore, the Owner will furnish to the Contractor a tax-exempt number issued by the State of Missouri for the construction of this project. Sales tax shall not be included in the Contractor’s Bid Proposal.

16.2 Federal Requirements

16.2.1 Each Contractor agrees to abide by all federal requirements, including Equal Employment Opportunity (Article 15.1), the Clean Air Act, the Federal Water Pollution Control Act and such other federal, state or local laws applicable to this project and to furnish any certification required by any federal, state or local government agency in connection with same.

16.3 Employee Screening

16.3.1 Comply with Owner’s requirements for drug and background screening of each Contractor’s personnel working on Project Site, and as follows:

1) Maintain list of approved screened personnel with Owner’s representative and Construction Manager.

2) As a condition of award of any contract in excess of $5,000.00 by the Park Hill School District, the service provider/contractor must be enrolled in and currently participating in “E-Verify” or any other equivalent electronic verification of work authorization program operated by the U.S. Department of Homeland Security.

a) “E-Verify” forms are included in Section 008400 “Attachments” for Contractor’s use, duplication and submittal with bid.
3) As a further condition for the award of any contract in excess of $5,000.00 by the Park Hill School District, the service provider/contractor shall not knowingly employ any person who is an un-authorized alien in conjunction with the contracted services.

16.4 Sexual Harassment Policy

16.4.1 Comply with School District’s “Sexual Harassment Policy” for all personnel working on Project Site. Any Contractor, subcontractor, material supplier or vendor who violates District policy against sexual harassment will be immediately removed from the premises and will face potential legal action.
Missouri
Division of Labor Standards
WAGE AND HOUR SECTION

ERIC R. GREITENS, Governor

Annual Wage Order No. 24
Section 083
PLATTE COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by

Tammy Cavender
Acting Department Director
Division of Labor Standards

This Is A True And Accurate Copy Which Was Filed With The Secretary of State: March 10, 2017

Last Date Objections May Be Filed: April 10, 2017

Prepared by Missouri Department of Labor and Industrial Relations
<table>
<thead>
<tr>
<th>OCCUPATIONAL TITLE</th>
<th>** Date of Increase</th>
<th>Basic Hourly Rates</th>
<th>Over-Time Schedule</th>
<th>Holiday Schedule</th>
<th>Total Fringe Benefits</th>
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<tr>
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<td>65</td>
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<tr>
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<tr>
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<tr>
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</tr>
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<td></td>
<td></td>
<td></td>
</tr>
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<td>$16.02</td>
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<tr>
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<tr>
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<td>63</td>
<td>68</td>
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<tr>
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<tr>
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<tr>
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<td>100</td>
<td>4</td>
<td>$10.90</td>
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<tr>
<td>Group IV</td>
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<td>100</td>
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<td>$10.90</td>
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Fringe Benefit Percentage is of the Basic Hourly Rate

**Annual Incremental Increase**
<table>
<thead>
<tr>
<th>OCCUPATIONAL TITLE</th>
<th>** Date of Increase</th>
<th>Basic Hourly Rates</th>
<th>Over-Time Schedule</th>
<th>Holiday Schedule</th>
<th>Total Fringe Benefits</th>
</tr>
</thead>
<tbody>
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<td></td>
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</tbody>
</table>

* Welders receive rate prescribed for the occupational title performing operation to which welding is incidental.

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

a - Vacation: Employees over 5 years - 8%, under 5 years - 6%
REPLACEMENT PAGE
PLATTE COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE

FED: Minimum requirement per Fair Labor Standards Act means time and one-half (1 ½) shall be paid for all work in excess of forty (40) hours per work week.

NO. 2: Means the maximum of eight (8) hours shall constitute a day's work beginning at 8:00 a.m. to 12:00 noon, 12:30 p.m. to 4:30 p.m. The maximum work week shall be forty (40) hours beginning Monday at 8:00 a.m. and ending Friday at 4:30 p.m. Because of traffic, parking or other circumstances, the hours of work on any project may be any continuous 8 ½ hours period (8 hours of work plus 30 minutes for lunch) between 7:00 a.m. and 4:30 p.m. When circumstances warrant and when it is mutually beneficial and agreed to, the Employer may institute a work week consisting of four (4) consecutive ten (10) hour days, between the hours of 7:00 a.m. and 6:00 p.m. Monday through Thursday, with one-half (½) hour allowed for a lunch period each day. Friday may be used as a make-up day. After ten (10) hours in a workday, or forty (40) hours in a workweek, overtime shall be paid at a rate of one and one-half (1½) times the regular rate of pay. Overtime performed Monday through Saturday shall be paid at the rate of one and one-half (1½) times the regular rate of pay. Sundays and recognized holidays shall be paid at the double (2) time rate of pay. Labor Day shall be paid at triple (3) time. Shift work may be performed at the option of the Contractor. However, whenever shift work is performed it must cover a period not less than (5) consecutive working days. The day shift shall work a regular eight (8) hours shift as outlined above. Employees working a second shift shall receive an additional $0.25 above the regular hourly rate and perform seven and one-half (7½) hours work for eight (8) hours pay. Third shift employees shall be paid an additional $0.50 above the regular hourly rate and work seven (7) hours for eight (8) hours pay. In the event a first shift is not required, a second and third shift employee shall receive an additional 15% of the base rate and receive pay for actual hours worked.

NO. 13: Means a regular workday shall consist of eight (8) hours between 8:00 a.m. and 4:30 p.m. Forty (40) hours, within five (5) days -- Monday through Friday inclusive -- shall constitute the regular workweek. The Employer may alter the above stated hours by two (2) hours for an early starting and quitting time only, not to exceed eight (8) hours of work in any one day. When job conditions dictate and as required by the customer, the Employer shall be allowed to establish a four (4) day, ten (10) hour per day work week. This work week is defined as Monday through Thursday, with a Friday make-up day. The normal work day under a ten (10) hour four (4) day work week shall be from 7:00 a.m. to 6:00 p.m., with a one hour starting variance. The make-up day of Friday shall be instituted for specific reasons such as loss of production due to weather and/or holidays. All hours worked in excess of ten (10) hours per day or forty (40) hours per week or hours worked outside the normal work week shall be paid at the applicable overtime rate. The first four (4) hours of overtime after the normal workday, each day Monday through Friday and the first ten (10) hours of overtime on Saturdays shall be paid for at one and one-half (1½) times the regular straight time rate of pay. All other work performed outside of the regularly scheduled working hours and outside of the first ten (10) hours worked on Saturdays shall be paid for at double (2) the regular straight time rate of pay. Sundays and the recognized holidays shall be paid for at double (2) the regular straight time rate of pay, if worked. When so elected by the contractor, multiple shifts of at least five (5) days duration may be worked. When two (2) or three (3) shifts are worked: The first shift (day shift) shall be worked between the hours of 8:00 a.m. and 4:30 p.m. Workmen on the "day shift" shall receive eight (8) hours pay at the regular hourly rate for eight (8) hours work. The second shift (swing shift) shall be worked between the hours of 4:30 p.m. and 12:30 a.m. Workmen on the "swing shift" shall receive eight (8) hours pay at the regular hourly rate plus 10% for seven and one-half (7 ½) hours work. The third shift (graveyard shift) shall be worked between the hours of 12:30 a.m. and 8:00 a.m. Workmen on the "graveyard shift" shall receive eight (8) hours pay at the regular hourly rate plus 15% for seven (7) hours work. A lunch period of thirty (30) minutes shall be allowed on each shift. All overtime work required after the completion of a regular shift shall be paid at one and one-half (1½) times the "shift" hourly rate.

NO. 14: Means eight (8) hours per day shall constitute a day's work. The regular starting time shall be 8:00 a.m., and the regular quitting time shall be 4:30 p.m.; lunch time shall be twelve (12) o'clock noon to 12:30 p.m. The regular starting time may, by mutual consent of employees on the job site, and the employer, be between 7:00 a.m. and 9:00 a.m. with appropriate adjustments made to the regular quitting time and lunch time. All time worked before the regular starting time and after the regular quitting time, Monday through Friday, shall be paid at the rate of time and one-half (1½). Four (4) days at ten (10) hours a day may be worked at straight time. All work commencing with the beginning of the established work day on Saturday shall be paid at the rate of time and one-half (1½). All work commencing with the beginning of the established work day on Sundays and/or Holidays shall be paid at the rate of double (2) time.
REPLACEMENT PAGE
PLATTE COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE

**NO. 17:** Means the regular working day shall consist of eight (8) hours of labor between 7:00 a.m. and 3:30 p.m. and the regular work week shall consist of five (5) consecutive eight (8) hour days of labor beginning on Monday and ending with Friday of each week. All full-time or part-time labor performed during such hours shall be recognized as regular working hours and paid for at the regular hourly rate. Except as otherwise provided, all work performed outside of regular working hours during the regular work week, shall be at double (2) times the regular rate. Working hours may be varied by two (2) hours. When circumstances warrant and when it is mutually beneficial and agreed to by interested parties, the Employer may institute a work week consisting of four (4) consecutive ten (10) hour days, between the hours of five (5) a.m. and six (6) p.m., Monday through Thursday, with one-half (1/2) hour allowed for a lunch period each day. Friday may be used as a make-up day. The make-up day will be voluntary, and a decision not to work may not be held against the employee. When working four (4) ten (10) hour day's overtime will be paid at the time and one-half (1½) rate for the eleventh (11th) and twelfth (12th) hour, all other work will be paid at the double (2) time rate of pay. The first two (2) hours of overtime, Monday through Friday, and the first eight (8) hours on Saturday shall be at time and one-half (1½) for all work. All other overtime shall be at double (2) time. The first two (2) hours of overtime must be concurrent with the regular work day; two (2) hours prior to or following the regular work day are at time and one-half (1½). The regular workday (as previously defined) on Saturday is paid at time and one-half (1½). Work performed outside of the regular Saturday work day is at double (2) time. All work performed on recognized holidays, or days locally observed as such, and Sundays shall be paid at the double (2) time rate of pay.

**NO. 25:** Means regular working hours of eight (8) hours shall constitute a working day between the hours of 8:00 a.m. to 4:30 p.m. in a forty (40) hour working week of Monday through Friday. Employment on Saturday, Sunday and legal holidays, and employment before or after the regular working hours shall be considered overtime. Employment on Saturday, Sunday and legal holidays shall be paid for at twice (2) the regular hourly rate. Employment from 4:30 p.m. to 12:00 midnight, Monday through Friday, shall be paid for at one and one-half (1½) times the regular hourly rate. From 12:00 midnight until 8:00 a.m. on any day shall be paid for at twice (2) the regular hourly rate.

**NO. 26:** Means that the regular working day shall consist of eight (8) hours worked between 6:00 a.m., and 5:00 p.m., five (5) days per week, Monday to Friday, inclusive. Hours of work at each jobsite shall be those established by the general contractor and worked by the majority of trades. (The above working hours may be changed by mutual agreement). Work performed on Construction Work on Saturdays, Sundays and before and after the regular working day on Monday to Friday, inclusive, shall be classified as overtime, and paid for at double (2) the rate of single time. The employer may establish hours worked on a job site for a four (4) ten (10) hour day work week at straight time pay for construction work; the regular working day shall consist of ten (10) hours worked consecutively, between 6:00 a.m. and 6:00 p.m., four (4) days per week, Monday to Thursday, inclusive. Any work performed on Friday, Saturday, Sunday and holidays, and before and after the regular working day on Monday to Thursday where a four (4) ten (10) hour day work week has been established, will be paid at two times (2) the single time rate of pay. The rate of pay for all work performed on holidays shall be at two times (2) the single time rate of pay.

**NO. 30:** Means Monday through Sunday shall constitute the work week. Regular starting time shall be 8:00 A.M., except when the work week is scheduled as a week with starting time advanced or delayed. Starting time may be advanced or delayed by the employer up to two (2) hours from the regular starting time. Eight (8) hours shall constitute the work day. All work performed prior to or after the regular eight (8) hour work day, as described above, and all work performed on Saturday shall be paid at time and one-half (1½) the regular rate. In the event that a scheduled eight (8) hour work day is missed (not to include holidays) because of events out of the control of the contractor, then that missed work day may be made up at straight time the following Saturday. It is recognized that not all employees working on a Saturday make-up day will have worked the same number of hours during the regular work week. It is further recognized that any work after the forty (40) hours in a week must be paid at time and one-half (1½). Saturday make-up day shall not be used to make up for time lost due to recognized holidays. The employer may establish a 4-10's schedule on projects (4 days with 10 hours per day). If using a 4-10’s schedule, a Friday make-up day is allowed. If using a 4 (10) schedule, any work more than ten (10) hours in a day or forty (40) hours in a work week shall be paid at the time and one-half (1½) rate. Friday make-up day shall not be used to make up for time lost due to recognized holidays. All work performed on Sundays or holidays shall be paid at the double (2) time rate.
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NO. 37: The Employer may choose, at his discretion, to work five eight hour days or four ten hour days with a Friday make-up day, Monday through Friday at straight time. Overtime shall be paid after eight (8) hours when working “five eights” and after ten hours when working “four tens”. All work performed on Sundays and recognized holidays shall be paid for at the rate of double (2) time. All Saturday work shall be paid for at the rate of time and one-half (1½) the regular wage rate. All night work during the regular work week other than the above-mentioned days shall be paid for at the rate of time and one-half (1½) the regular wage scale until midnight and double (2) time after midnight except make-up time will be allowed under the following condition: In the event of inclement weather on exterior projects which prevents working the full regular eight (8) hour day, forty (40) hour work week schedule, a Saturday make-up day can be granted. Then said work on Saturday shall be paid at the straight time rate of pay up to a maximum total of forty (40) hours per week.

NO. 45: Means eight (8) hours shall constitute a day’s work, beginning at 8:00 a.m. and ending at 4:30 p.m. The regular work week shall be forty (40) hours, beginning Monday, 8:00 a.m. and ending at 4:30 p.m. Friday. Because of traffic, parking and other circumstances, the hours of work on any project may begin as early as 6:00 a.m. with eight (8) hours worked between 6:00 a.m. and 4:30 p.m. When circumstances warrant and when it is mutually beneficial and agreed to, the employer may institute a work week consisting of four (4) consecutive ten (10) hour days, between the hours of 7:00 a.m. and 6:00 p.m., Monday through Thursday. Friday may be used as a make-up day. After ten (10) hours in a workday, or forty (40) hours in a workweek, overtime shall be paid at a rate of one and one-half (1½) times the regular rate of pay. All overtime Monday through Saturday shall be paid at the rate of time and one-half (1½) the regular rate of pay. Sunday and recognized holidays shall be paid at double (2) time. Labor Day shall be paid at triple (3) time. Shift work may be performed at the option of the Contractor. However, whenever shift work is performed it must cover a period not less than (5) consecutive working days. The day shift shall work a regular eight (8) hours shift as outlined above. The hourly rate for second shift (seven and one-half hours worked for eight hours paid) shall be twenty-five cents ($0.25) over and above the hourly rate. The hourly rate for third shift (seven hours worked, eight hours paid) shall be fifty cents ($0.50) above the hourly rate. If no first shift is worked, second and third shift employees shall receive an additional fifteen percent (15%) over and above the hourly rate for actual hours worked.

NO. 46: Means the regular work day shall be eight (8) hours from 6:00 a.m. to 6:30 p.m. Starting time may be between 6:00 a.m. and 10:00 a.m. The regular work week shall be forty (40) hours, beginning between 6:00 a.m. and 10:00 a.m. on Monday and ending between 2:30 p.m. and 6:30 p.m. on Friday. All hours in excess of the regular work day and work week shall be considered overtime. Overtime on days recognized as regular work days and on Saturday shall be paid for at the rate of time and one-half (1½) the regular rate. Sunday and recognized holidays shall be paid for at the rate of double time (2) for time worked. The Employer may establish a work week consisting of four (4) days, Monday through Thursday, each day consisting of ten (10) hours at straight time rate of pay. The 4-10’s must run for a period of at least four (4) days.

NO 47: Means a regular workday shall consist of eight (8) hours between 6:00 a.m. and 6:30 p.m. Forty (40) hours, within five (5) days – Monday through Friday or Tuesday through Saturday inclusive – shall constitute the regular workweek. The Employer may alter the above stated hours by two (2) hours for an early starting and quitting time only, not to exceed eight (8) hours of work in any one day. The Employer shall be allowed to establish a four (4) day, ten (10) hour per day work week. This work week is defined as Monday through Thursday, with a Friday make-up day. The normal work day under a ten (10) hour four (4) day work week shall be from 7:00 a.m. to 6:00 p.m. All hours worked in excess of ten (10) hours per day or forty (40) hours per week or hours worked outside the normal work week shall be paid at the applicable overtime rate. The first four (4) hours of overtime after the normal workday, each day Monday through Friday and the first ten (10) hours of overtime on Saturdays shall be paid for at one and one-half (1½) times the regular straight time rate of pay. All other work performed outside of the regularly scheduled working hours and outside of the first ten (10) hours worked on Saturdays shall be paid for at double (2) the regular straight time rate of pay. Sundays and the recognized holidays shall be paid for at double (2) the regular straight time rate of pay, if worked. When so elected by the contractor, multiple shifts of at least five (5) days duration may be worked. When two (2) or three (3) shifts are worked: The first shift (day shift) shall be worked between the hours of 8:00 a.m. and 4:30 p.m. Workmen on the “day shift” shall receive eight (8) hours pay at the regular hourly rate for eight (8) hours work. The second shift (swing shift) shall be worked between the hours of 4:30 p.m. and 12:30 a.m. Workmen on the “swing shift” shall receive eight (8) hours pay at the regular hourly rate plus 10% for seven and one-half (7 ½) hours work. The third shift (graveyard shift) shall be worked between the hours of 12:30 a.m. and 8:00 a.m. Workmen on the “graveyard shift” shall receive eight (8) hours pay at the regular hourly rate plus 15% for seven (7) hours work. A lunch period of thirty (30) minutes shall be allowed on each shift. All overtime work required after the completion of a regular shift shall be paid at one and one-half (1½) times the “shift” hourly rate.
NO. 48: Means the regularly scheduled work week shall be five (5) consecutive days, Monday through Friday or Tuesday through Saturday. Eight (8) hours shall constitute a day's work. Starting time shall not be earlier than 7:00 a.m. nor later than 10:00 a.m. Forty (40) hours shall constitute a week's work. Overtime at the rate of time and one-half (1½) will be paid for all work in excess of forty (40) hours in any one work week. On the Monday through Friday schedule, all work performed on Saturday will be time and one-half (1½) unless time has been lost during the week, in which case Saturday will be a make up day to the extent of the lost time. On the Tuesday through Saturday schedule, all work performed on Monday will be time and one-half (1½) unless time has been lost during the week, in which case Monday will be a make-up day to the extent of the lost time. Any work performed on Sunday will be double (2) time. If employees work on any of the recognized holidays, they shall be paid time and one-half (1½) their regular rate of pay for all hours worked.

NO. 50: Means eight (8) hours constitute a normal day's work Monday through Friday. Any time worked over eight (8) hours will normally be paid at time and one-half (1½) except for exclusions stated in some following additional sentences. The Employer, at his discretion, may start the work day between 6:00 a.m. and 9:00 a.m. Any schedule chosen shall be started at the beginning of the work week (Monday) and used for at least five days. Work may be scheduled on a four (4) days a week (Monday through Thursday) at ten (10) hours a day schedule. If such a schedule is employed, then Friday may be used as a make-up day when time is lost due to inclement weather. Time and one-half (1½) shall be paid for any work in excess of eight (8) hours in any regular work day Monday through Friday unless working 4-10's, then time and one-half (1½) after ten (10) hours. All work performed on Saturday will be time and one-half (1½). Double (2) time shall be paid for all work on Sundays and recognized holidays.

NO. 52: Means the regular workweek shall consist of five (5) eight (8) hour days, Monday through Friday. The regular workday shall consist of an eight (8) hour period, to be worked between the agreed upon starting time and ending no later than 4:30 p.m. The agreed upon starting time shall be any time between the hours of 6:00 a.m. and 8:00 a.m. The option exists for the employer to use a four (4) day, ten (10) hour work week. Days worked shall be Monday through Thursday or Tuesday through Friday. If the job requires men on duty all five (5) days, then part of the crew may work the first four (4) days and the remainder of the crew may work the last four (4) days. Hours each day shall be from 7:00 a.m. to 5:30 p.m. Interested parties on the project must agree to this clause before it may be used. Once this clause has been put into effect, it shall remain as long as the majority of the Employees on the project and the Employer agree to keep it. The four (4) day clause shall not be used to circumvent a Holiday. Except as otherwise provided, all work performed outside the regular working hours and performed during the regular work week (Monday through Friday) shall be at the following rates of pay:

- Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, Christmas Day (or days observed as such) shall be recognized as Holidays that shall be paid at two (2) times the regular rate of pay.
- Labor Day: No work shall be performed on Labor Day except in special cases of emergency. Rate of pay shall be at three (3) times the regular rate of pay.
- Overtime: Work performed outside of the regular work day (the regular work day shall consist of an eight (8) hour period, to be worked between the agreed upon starting time and ending not later than 4:30 p.m. The agreed upon starting time shall be any time between the hours of 6:00 a.m. and 8:00 a.m., by mutual consent of the interested party's.), shall be:
  A. Hours worked Monday through Friday, the first two (2) hours of overtime will be paid at time and one-half (1½). All other overtime will be paid at the double (2) time rate.
  B. The first ten (10) hours worked on Saturday will be paid at time and one-half (1½), with all other hours to be paid at the double (2) time rate.
  C. Sundays and Holidays (except Labor Day) shall be paid at the double (2) time rate.
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BUILDING CONSTRUCTION - OVERTIME SCHEDULE

NO. 57: Means eight (8) hours per day shall constitute a day’s work and forty (40) hours per week, Monday through Friday, shall constitute a week’s work. The regular starting time shall be 8:00 a.m. If a second or third shift is used, the regular starting time of the second shift shall be 4:30 p.m. and the regular starting period for the third shift shall be 12:30 a.m. These times may be adjusted by the employer. The day shift shall work a regular eight (8) hours shift as outlined above. Employees working a second shift shall receive an additional $0.25 above the regular hourly rate and perform seven and one-half (7½) hours work for eight (8) hours pay. Third shift employees shall be paid an additional $0.50 above the regular hourly rate and work seven (7) hours for eight (8) hours pay. When circumstances warrant, the Employer may change the regular workweek to four (4) ten-hour days at the regular time rate of pay. All time worked before and after the established workday of eight (8) hours, Monday through Friday, and all time worked on Saturday shall be paid at the rate of time and one-half (1½) except in cases where work is part of an employee’s regular Friday shift. All time worked on Sunday and recognized holidays shall be paid at the double (2) time rate of pay except in cases where work is part of an employee’s previous day’s shift. For all overtime hours worked $27.76 of the fringe benefits portion of the prevailing wage shall be paid at the same overtime rate at which the cash portion of the prevailing wage is to be paid. The remaining $1.37 of the fringe benefit portion of the prevailing wage may be paid at straight time.

NO. 58: Means eight (8) consecutive hours, between 6:00 a.m. and 5:30 p.m., shall constitute a day’s work. Five (5) days work, Monday through Friday, shall constitute a normal work week. Work performed in excess of eight (8) hours per day or eight hours beyond normal starting time for that project excluding lunch Monday through Friday, and all work performed on Saturday, shall be paid for the rate of time and one-half (1½). When Sundays and recognized holidays are worked, the worker(s) shall be paid at the rate of double (2) time. Work may be scheduled on a four (4) days a week (Monday through Thursday) at ten (10) hours a day schedule at straight time. A Friday make-up day is available if time is lost due to inclement weather and at least sixteen (16) hours, but not more than thirty (30) hours, were worked during the week.

NO. 63: Means eight (8) hours shall constitute the regular work day between time that may be advanced or delayed by two (2) hours on either side of 8:00 AM. The Employer may establish a work week consisting of four (4) days, Monday through Thursday, each day consisting of ten (10) hours straight time. The four (4) tens (10’s) must run for a period of at least four (4) days, Monday through Thursday. All work on Friday on a four (4) tens (10) project will be paid at the rate of time and one-half (1½). All work performed on Saturday shall be paid at time and one-half (1½). All work performed on Sundays and recognized holidays must be paid at double (2) time. All work performed prior to or after the regular eight (8) hour work day, or ten (10) hour work day, as described above shall be paid at time and one-half (1½) the regular rate.

NO. 65: Means Monday through Sunday shall constitute the work week. Regular starting time shall be 8:00 a.m., with one half hour for lunch between three and one-half (3½) and five (5) hours after starting time. The starting time may be advanced by two (2) hours or delayed one (1) hour by the employer from the regular starting time. All work performed before the advanced starting time and during the half hour lunch shall be paid at the overtime rate of time and one-half (1½). Work performed outside these hours shall be paid at the overtime rate of time and one-half (1½), except as provided otherwise below. All work performed on Sundays or recognized holidays shall be paid at the double (2) time rate. When the start time is delayed past 9:00 a.m., the employee’s pay shall start at 9:00 a.m. and all time, after the normal quitting time (5:30 p.m.), shall be paid at the overtime rate. Eight (8) hours shall constitute the work day. All work performed prior to or after the regular eight (8) hour work day, as described above, and all work performed on Saturday shall be paid at time and one-half (1½) the regular rate. In the event that a scheduled eight (8) hour work day is missed (not including recognized holidays) because of inclement weather, then that missed work day may be made up at straight time on the following Saturday. It is recognized that not all employees working on a Saturday make-up day will have worked the same number of hours during the regular work week. It is further recognized that any work after forty (40) hours must be paid at time and one-half (1½). The employer may establish a 4-10’s schedule on projects (4 days with 10 hours per day at straight time). In order to use the 4-10’s schedule, the employer must schedule the 4-10’s for a minimum of one (1) week. If using a 4-10’s schedule, a Friday make-up day is allowed.
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NO. 68: Means Monday through Sunday shall constitute the work week. Regular starting time shall be 8:00 a.m., with one half hour for lunch between three and one-half and five hours after starting time. The starting time may be advanced or delayed by the employer up to one hour from the regular starting time. All work performed before the advance starting time and during the half hour lunch shall be paid at the overtime rate of time and one-half (1½). Work performed outside these hours shall be paid at the overtime rate of time and one-half (1½), except as provided otherwise below. All work performed on Sundays or holidays shall be paid at the double (2) time rate. Eight (8) hours shall constitute the work day. All work performed prior to or after the regular eight (8) hour work day, as described above, and all work performed on Saturday shall be paid at time and one-half (1½) the regular rate, except as hereinafter described. In the event that a scheduled eight (8) hour work day is missed (not including recognized holidays) because of inclement weather, then missed work day may be made up at straight time on the Saturday in the week of the pay period. It is recognized that not all employees working on a Saturday make-up day will have worked the same number of hours during the regular work week. It is further recognized that any work after forty (40) hours must be paid at time and one-half (1½). The employer may establish a 4-10's schedule on projects (4 days with 10 hours per day at straight time). In order to use the 4-10's schedule, the employer must schedule the 4-10's for a minimum of one (1) week. If using a 4-10's schedule, a Friday make-up day is allowed.

NO. 85: Means the work week shall be Monday through Sunday. Eight (8) hours shall constitute a day's work to begin between 6:00 a.m. and 9:00 a.m. and end between 2:30 p.m. to 5:30 p.m. Employees required to work during their lunch period shall receive the overtime rate. Employees shall receive time and one-half (1½) for all time they are required to work prior to their normal starting time or after eight (8) hours or normal quitting time Monday through Friday, or all day on Saturday. If an Employer has started the work week on a five day, eight hours a day schedule, and due to inclement weather misses any time, then he may switch to a nine or ten hours a day schedule, at straight time, for the remainder of that work week in order to make up for the lost time (10-hour make-up day). All work over ten (10) hours a day or over forty (40) hours a week must be paid at time & one-half (1½). Sundays and recognized holidays shall be paid at the double (2) time rate of pay. A contractor may alter the regular work week to four (4) ten (10) hour days at straight time rate of pay. To do this the scheduled 4-10's must be worked at least one full week and the regular workweek shall be Monday through Thursday with Friday being a make-up day at straight time for days missed in the regular workweek due to inclement weather. If 5-8's are being worked, Saturday may be used as a make-up day at straight time if inclement weather prevents work during the normal work week.

NO. 88: Means the regular work week shall consist of five (5) eight (8) hour days, 7:00 a.m. to 3:30 p.m., Monday through Friday, except when the work week is scheduled as a 4-10's week or as a week with start time advanced or delayed as described below. The starting time may be advanced or delayed by one hour on either side of 7:00 a.m. The advanced or delayed starting time must run for a period of at least five (5) days. The Employer may establish a work week consisting of four (4) days, during the regular work week, each day consisting of ten (10) hours at straight time. The 4-10's must run for a period of at least four (4) days. Time and one-half (1½) shall be paid for any work in excess of eight (8) hours in any normal work day Monday through Friday (or ten hours in a 4-10's week), the first eight (8) hours of a Saturday, and it shall be at time and one-half (1½) for the Friday and Saturday following Thanksgiving. Double (2) time shall be paid for the following time worked on Sunday, New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day, as well as any work in excess of eight (8) hours on a Saturday and the Saturday of a three-day weekend (except the Saturday following Thanksgiving).

NO. 95: Means a regular workday shall consist of eight and one-half (8½) hours elapsed time, including one-half hour for lunch. The crew starting times shall be flexible within the period of daylight to 8:00 a.m. Any work performed over ten (10) hours of elapsed time per day including one-half hour for lunch and/or any work performed over forty (40) hours at the straight time rate in one week shall be paid at time and one-half (1½) the straight time rate. Saturday shall be a voluntary make-up day at straight time at the discretion of the contractor and with the consent of the employees. Sunday and recognized holidays shall be paid for at double (2) time.
NO. 100: Means eight (8) hours shall constitute a day's work, and five (5) continuous eight-hour days shall constitute a week's work, Monday through Friday. Time and one-half (1½) the regular hourly rate shall be paid for all work performed in excess of eight (8) hours in any one day or forty (40) hours in any one week. Starting time shall be between 6:00 a.m. and 9:00 a.m. All work over eight (8) hours in a regular 5-day 8-hour schedule shall be at the appropriate overtime rate. All time worked before the regular scheduled starting time shall be paid for at the rate of time and one-half (1½) and shall not apply to regular shift. All time worked after eight (8) hours in any one day or after 5:30 p.m., whichever comes first, shall be paid at the time and one-half (1½) rate. An Employer, at his option, may elect to work four (4) ten (10) hour days, Monday through Thursday, at straight time. All such work must be done at least one week in duration. All work over ten (10) hours in one day or forty (40) hours in a week shall be at the overtime rate. Any employee who is scheduled to work on any regular work day but is prevented from working because of weather conditions, shall be permitted to work on Saturday (Friday if working 4-10's) as a make-up day at the straight time rate of pay. When an employee is required to work on any recognized holiday they shall receive the double (2) time rate for all time that they are required to perform work. All time worked from 12:00 Midnight Saturday to 12:00 Midnight Sunday shall be paid for at the rate of double (2) time on single shift.

NO. 125: Eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within the five (5) days, Monday through Friday inclusive, shall constitute the work week. Starting time may be adjusted not to exceed two (2) hours. Work performed outside of the aforementioned will be paid at the applicable overtime rate. When starting time has been adjusted, all other provisions concerning the work day shall be adjusted accordingly. The overtime rate of pay shall be one and one-half (1½) times the regular rate of wages, other than on Sundays, holidays and from Midnight until 6:00 a.m., which will be paid at double (2) the straight time rate.
PLATTE COUNTY
HOLIDAY SCHEDULE – BUILDING CONSTRUCTION

NO. 2: All work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or the days observed as such, shall be paid at the double time rate of pay.

NO. 4: All work done on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving and Christmas Day shall be paid at the double time rate of pay. If any of the above holidays fall on Sunday, Monday will be observed as the recognized holiday. If any of the above holidays fall on Saturday, Friday will be observed as the recognized holiday and holidays falling on Sunday will be observed on the following Monday.

NO. 7: The following days are assigned and are recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, and Christmas Day. If a holiday falls on a Sunday, it shall be observed on the following Monday. If a holiday falls on a Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This is applied to protect Labor Day. When a holiday falls during the normal workweek, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week. However, no reimbursement for these eight (8) hours is to be paid to the workman unless worked. If workman are required to work the above enumerated holidays or days observed as such, or on Sunday, they shall receive double (2) the regular rate of pay for such work.

NO. 22: All work performed on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Day, or days locally observed as such, and Sunday shall be recognized as holidays. If a holiday falls on Saturday, Friday shall be observed; if it falls on Sunday, Monday shall be observed. All work performed on holidays shall be paid at the double (2) time rate of pay.

NO. 32: All work performed for the Friday and Saturday following Thanksgiving shall be paid at the time and one-half (1½) rate of pay. All work performed on Sundays, New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day shall be paid at the double (2) time rate of pay. When one of the above holidays falls on Sunday, the following Monday shall be observed and when one of the above holidays falls on Saturday, the preceding Friday shall be observed.

NO. 33: All work done on New Year's Day, Memorial Day, Fourth of July, Thanksgiving Day and Christmas Day shall be paid at the double time rate of pay. Labor Day shall be paid at the triple (3) time rate of pay. If the holiday falls on Sunday, the following Monday will be observed; if the holiday falls on Saturday, the preceding Friday will be observed.

NO. 39: No work shall be done on the following holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, and Christmas. Any of these holidays falling on Sunday, the following Monday shall be a holiday, and any of these holidays falling on Saturday, the preceding Friday shall be a holiday.

NO. 49: The following days shall be observed as legal holidays: New Year's Day, Decoration Day, July 4th, Labor Day, Thanksgiving Day, Christmas Day, Employee's birthday and two (2) personal days. The observance of one (1) of the personal days to be limited to the time between December 1 and March 1 of the following year. If any of these holidays fall on Sunday, the following Monday will be observed as the holiday and if any of these holidays fall on Saturday, the preceding Friday will be observed as the holiday. If employees work on any of these holidays they shall be paid time & one-half (1½) their regular rate of pay for all hours worked.

NO. 53: All work done on New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, Christmas Day or days observed as such for these holidays shall be paid at the double (2) time rate of pay. No work shall be performed on Labor Day except in special cases of emergency, and then the rate of pay shall be at three (3) times the regular rate of pay. When a holiday falls on a Sunday, the following Monday shall be observed as the holiday. When a holiday falls on Saturday, the preceding Friday shall be observed as the holiday.

NO. 54: All work performed on New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving Day, and Christmas Day shall be paid at the double (2) time rate of pay. When a holiday falls on Saturday, it shall be observed on Friday. When a holiday falls on Sunday, it shall be observed on Monday.

ANNUAL WAGE ORDER NO. 24
NO. 65: Work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or days celebrated as such, shall be paid at the double time rate of pay. If the holiday falls on Saturday, it will be observed on Friday; if the holiday falls on Sunday, it will be observed on Monday, and shall be paid for at double (2) the regular straight time rate of pay.

NO. 67: All work performed on New Year's Day, Memorial Day, Christmas Day, Fourth of July and Thanksgiving Day, from midnight to midnight, shall be paid for at the rate of double time (2) the basic rate of pay if required to work in addition to any other pay otherwise required hereunder as holiday pay. Positively no work shall be performed on Labor Day. Martin Luther King's Birthday, Veteran's Day, and the day after Thanksgiving Day shall be considered optional holidays, and if the Employer and employees agree that work will be performed on that day, no premium pay will be required. Should any of the above holidays fall on Saturday, the holiday will be observed on Friday. Should any of the above holidays fall on Sunday, the holiday will be observed on Monday.

NO. 68: All work performed on New Year's Day, Decoration Day (Memorial Day), Independence Day (Fourth of July), Labor Day, Thanksgiving Day, Christmas Day, or days observed as such, shall be paid at the rate of double (2) time. When a holiday falls on a Saturday, Friday shall be observed. When a holiday falls on a Sunday, Monday shall be observed. No work shall be performed on the Fourth of July or Labor Day except to save life or property. Where one of the holidays specified falls or is observed during the work week, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½).

NO. 72: All work performed on New Year's Day, Memorial Day (last Monday in May), Independence Day, Labor Day, Thanksgiving Day and Christmas Day shall be paid for at double (2) the regular straight time rate of pay. Any one of the above listed holidays falling on Sunday shall be observed on the following Monday and paid for at double (2) the regular straight time rate of pay, if worked. Any one of the above listed holidays falling on Saturday shall be observed on the prior Friday and paid for at double (2) the regular straight time rate of pay, if worked. No work shall be performed on Labor Day except in case of emergency.
<table>
<thead>
<tr>
<th>OCCUPATIONAL TITLE</th>
<th>* Date of Increase</th>
<th>Basic Hourly Rates</th>
<th>Over-Time Schedule</th>
<th>Holiday Schedule</th>
<th>Total Fringe Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carpenter</td>
<td>6/17</td>
<td>$37.73</td>
<td>1</td>
<td>17</td>
<td>$16.85</td>
</tr>
<tr>
<td>Cement Mason</td>
<td></td>
<td>$31.50</td>
<td>3</td>
<td>2</td>
<td>$16.77</td>
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<tr>
<td>Electrician (Outside-Line Construction</td>
<td>Lineman)</td>
<td></td>
<td>$42.87</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Lineman Operator</td>
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<td>$39.62</td>
<td>18</td>
<td>24</td>
<td>$5.25 + 34.5%</td>
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<tr>
<td>Lineman - Tree Trimmer</td>
<td></td>
<td>$22.51</td>
<td>31</td>
<td>30</td>
<td>$5.50 + 28%</td>
</tr>
<tr>
<td>Groundman</td>
<td></td>
<td>$27.63</td>
<td>18</td>
<td>24</td>
<td>$5.25 + 34.5%</td>
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<tr>
<td>Groundman - Tree Trimmer</td>
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<td>$18.21</td>
<td>31</td>
<td>30</td>
<td>$5.50 + 28%</td>
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<tr>
<td>Laborer</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>General Laborer</td>
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<td>2</td>
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<tr>
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<td>$15.23</td>
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<td>Millwright</td>
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<td>17</td>
<td>$16.85</td>
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<tr>
<td>Operating Engineer</td>
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<tr>
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<td>3</td>
<td>2</td>
<td>$16.84</td>
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<tr>
<td>Group II</td>
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<td>3</td>
<td>2</td>
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<tr>
<td>Group III</td>
<td>6/17</td>
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<td>2</td>
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<tr>
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<tr>
<td>Oilier-Driver</td>
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<tr>
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<td></td>
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<td></td>
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<tr>
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<td>6/17</td>
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<td>3</td>
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<td>$14.85</td>
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<tr>
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<td>6/17</td>
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<td>3</td>
<td>2</td>
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<tr>
<td>Group III</td>
<td>6/17</td>
<td>$31.49</td>
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<td>2</td>
<td>$14.85</td>
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<tr>
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<td>6/17</td>
<td>$31.49</td>
<td>3</td>
<td>2</td>
<td>$14.85</td>
</tr>
</tbody>
</table>

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate sheet.
PLATTE COUNTY
OVERTIME SCHEDULE - HEAVY CONSTRUCTION

FED: Minimum requirement per Fair Labor Standards Act means time and one-half (1 ½) shall be paid for all work in excess of forty (40) hours per work week.

NO. 1: Means (8) hours shall constitute the regular work day between time that may be advanced or delayed by two (2) hours on either side of 8:00 AM. The Employer may establish a work week consisting of four (4) days, Monday through Thursday, each day consisting of ten (10) hours straight time. The four (4) tens (10s) must run for a period of at least four (4) days, Monday through Thursday. All work on Friday on a four (4) tens (10) project will be paid at the rate of time and one-half (1½). All work performed on Saturday shall be paid at time and one-half (1½). All work performed on Sundays and recognized holidays must be paid at double (2) time. All work performed prior to or after the regular eight (8) hour work day, or ten (10) hour work day, as described above shall be paid at time and one-half (1½) the regular rate.

NO. 3: Means a regular work week shall consist of not more than forty (40) hours of work and all work performed over and above ten (10) hours per day or forty (40) hours per week shall be paid at the rate of time & one-half (1½). Workers shall receive time and one-half (½) for all work performed on Sundays and recognized holidays. Double (2) time shall be paid for work performed on Sundays or recognized holidays when and only if any other craft employees of the same employer at work on that same job site are receiving double (2) time pay for that Sunday or Holiday work. A work day is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer prevents work, in which event, the starting time may be delayed, but not later than 12:00 noon. Where one of the recognized holidays falls or is observed during the work week, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½).

NO: 18: Eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within the five (5) days, Monday through Friday inclusive, shall constitute the work week. Starting time may be adjusted not to exceed two (2) hours. Work performed outside of the aforementioned will be paid at the applicable overtime rate. When starting time has been adjusted, all other provisions concerning the work day shall be adjusted accordingly. The overtime rate of pay shall be one and one-half (1½) times the regular rate of wages, other than on Sundays, holidays and from Midnight until 6:00 a.m., which will be paid at double (2) the straight time rate.

NO. 27: Means the regularly scheduled work week shall be five (5) consecutive days, Monday through Friday or Tuesday through Saturday. Eight (8) hours shall constitute a day’s work. Starting time shall not be earlier than 7:00 a.m. nor later than 10:00 a.m. Forty (40) hours shall constitute a week’s work. Overtime at the rate of time and one-half (1½) will be paid for all work in excess of forty (40) hours in any one work week. On the Monday through Friday schedule, all work performed on Saturday will be time and one-half (1½) unless time has been lost during the week, in which case Saturday will be a make up day to the extent of the lost time. On the Tuesday through Saturday schedule, all work performed on Monday will be time and one-half (1½) unless time has been lost during the week, in which case Monday will be a make-up day to the extent of the lost time. Any work performed on Sunday will be double (2) time. If employees work on any of the recognized holidays, they shall be paid time and one-half (1½) their regular rate of pay for all hours worked.

NO. 31: Means the overtime rate shall be time and one-half the regular rate for work over forty (40) hours per week. Sundays and Holidays shall be paid at double the straight time rate. All employees performing work on affected properties during or following emergencies shall receive the applicable rate of pay for the first sixteen (16) consecutive hours and all hours worked in excess of sixteen (16) consecutive hours shall be paid at double time until broken by an eight (8) hour rest period. Should an employee be called back to work within two hours of his normal quitting time, the previous hours worked shall count toward the above sixteen (16) hour provision.
PLATTE COUNTY
HOLIDAY SCHEDULE – HEAVY CONSTRUCTION

NO. 2: All work performed on New Year's Day, Decoration Day (Memorial Day), Independence Day (Fourth of July), Labor Day, Thanksgiving Day and Christmas Day, or days observed as such, and Sundays shall be paid at the rate of time and one-half (1½). Double (2) time shall be paid for work on Sundays or recognized holidays when and only if other craft employees of the same employer at work on that same job site are receiving double (2) time pay for that Sunday or holiday work. No work shall be performed on Labor Day, except in case of jeopardy of life or property. This rule is applied to protect Labor Day. When one of the above holidays falls on a Saturday, the preceding Friday shall be observed; when the holiday falls on a Sunday, the following Monday shall be observed. Where one of the specified holidays falls or is observed during the work week, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½).

NO. 17: All work performed on New Year's Day, Decoration Day (Memorial Day), Independence Day (Fourth of July), Labor Day, Thanksgiving Day, Christmas Day, or days observed as such, shall be paid at the rate of double (2) time. When a holiday falls on a Saturday, Friday shall be observed. When a holiday falls on a Sunday, Monday shall be observed. No work shall be performed on the Fourth of July or Labor Day except to save life or property. Where one of the holidays specified falls or is observed during the work week, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½).

NO. 24: Work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or days celebrated as such, shall be paid at the double time rate of pay. If the holiday falls on Saturday, it will be observed on Friday; if the holiday falls on Sunday, it will be observed on Monday, and shall be paid for at double (2) the regular straight time rate of pay.

NO. 26: The following days shall be observed as legal holidays: New Year's Day, Decoration Day, July 4th, Labor Day, Thanksgiving Day, Christmas Day, Employee's birthday and two (2) personal days. The observance of one (1) of the personal days to be limited to the time between December 1 and March 1 of the following year. If any of these holidays fall on Sunday, the following Monday will be observed as the holiday and if any of these holidays fall on Saturday, the preceding Friday will be observed as the holiday. If employees work on any of these holidays they shall be paid time & one-half (1½) their regular rate of pay for all hours worked.

NO. 30: All work performed on New Year's Day, Decoration Day, Fourth of July, Labor Day, Christmas Day, Thanksgiving Day and Day after Thanksgiving or days celebrated for the same.
MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
PREVAILING WAGE
PROJECT NOTIFICATION – CONTRACTOR INFORMATION

The information below is requested pursuant to Sections 290.210 through 290.340 and 290.550 through 290.580, RSMo. During a time of excessive unemployment, only Missouri laborers and laborers from non-restrictive states shall be employed on public works projects. See 290.550 through 290.580, RSMo.

<table>
<thead>
<tr>
<th>1. Date of Notification</th>
<th>2. Annual Wage Order Number Included in Bid Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Popular or Descriptive Name of Project</td>
<td></td>
</tr>
<tr>
<td>4. Estimated Project Cost of Completion <em>(total construction contracts to be awarded)</em></td>
<td>$</td>
</tr>
<tr>
<td>5. Exact Location of Project</td>
<td></td>
</tr>
<tr>
<td>County</td>
<td>City</td>
</tr>
<tr>
<td>6. Official Name of Public Body or Agency</td>
<td></td>
</tr>
<tr>
<td>7. Name of Contact Person</td>
<td>8. Phone Number <em>(include area code)</em></td>
</tr>
<tr>
<td>9. Address</td>
<td></td>
</tr>
<tr>
<td>10. E-mail Address</td>
<td>Website</td>
</tr>
<tr>
<td>11. Anticipated Date for Soliciting or Advertising for Bids</td>
<td>12. Contract Award Date</td>
</tr>
</tbody>
</table>

| 13. Estimated Start Date of Work | 14. Estimated Date of Project Completion |
| 15. Will There Be Any Federal Funds Used in this Contract? |

| 16. Contractor Information Notification |
| General Contractor: |
| Name |
| Address |
| City | State | ZIP |
| Phone Number | E-mail Address |
| Type of Craftsmen Needed by Project |
| Scope of Work |

| List all Subcontractors: |
| Name |
| Address |
| City | State | ZIP |
| Phone Number | E-mail Address |
| Type of Craftsmen Needed by Project |
| Scope of Work |
| Name |
| Address |
| City | State | ZIP |
| Phone Number | E-mail Address |
| Type of Craftsmen Needed by Project |
| Scope of Work |

The state of Missouri requires workers on public works projects be paid the prevailing wage. Public bodies have duties as required under this law (Section 290.210 - 290.340, RSMo).

Mail, Fax or E-mail completed form to: DIVISION OF LABOR STANDARDS
Attn: Prevailing Wage Section
P.O. Box 449 Jefferson City, MO 65102-0449
Phone: 573-751-3403 Fax: 573-751-3721 E-mail: prevailingwage@labor.mo.gov Website: www.labor.mo.gov/DLS

PW-2 (08-11) AI
I, __________________________, upon being duly sworn upon my oath state that: (1) I am the __________________________ of __________________________; (2) all requirements of §§ 290.210 to 290.340, RSMo, pertaining to the payment of wages to workers employed on public works projects have been fully satisfied with regard to this company’s work on __________________________; (3) I have reviewed and am familiar with the prevailing wage rules in 8 CSR 30-3.010 to 8 CSR 30-3.060; (4) based upon my knowledge of these rules, including the occupational titles set out in 8 CSR 30-3.060, I have completed full and accurate records clearly indicating (a) the names, occupations, and crafts of every worker employed by this company in connection with this project together with an accurate record of the number of hours worked by each worker and the actual wages paid for each class or type of work performed, (b) the payroll deductions that have been made for each worker, and (c) the amounts paid to provide fringe benefits, if any, for each worker; (5) the amounts paid to provide fringe benefits, if any, were irrevocably paid to a trustee or to a third party pursuant to a fund, plan, or program on behalf of the workers; (6) these payroll records are kept and have been provided for inspection to the authorized representative of the contracting public body and will be available, as often as may be necessary, to such body and the Missouri Department of Labor and Industrial Relations; (7) such records shall not be destroyed or removed from the state for one year following the completion of this company’s work on this project; (8) when in effect, the requirements of §§ 290.550 through 290.580, RSMo, pertaining to excessive unemployment were fully satisfied; and (9) there has been no exception to the full and complete compliance with the provisions and requirements of Annual Wage Order No. ______ Section ______ issued by the Missouri Division of Labor Standards and applicable to this project located in _________________ County, Missouri, and completed on the ___ day of _________________, ______.

The matters stated herein are true to the best of my information, knowledge, and belief. I acknowledge that the falsification of any information set out above may subject me to criminal prosecution pursuant to §§290.340, 570.090, 575.040, 575.050, or 575.060, RSMo.

_______________________________
Signature

Subscribed and sworn to me this ____ day of _________________, ______.
My commission expires ________________________________, ______.

_______________________________
Notary Public

_______________________________
Receipt by Authorized Public Representative
MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
DIVISION OF LABOR STANDARDS
REQUEST FOR WAGE DETERMINATION

PLEASE RETURN TO: Division of Labor Standards
Attn: Prevailing Wage Section
P.O. Box 449
Jefferson City, MO 65102-0449
Phone: 573-751-3403
Fax: 573-751-3721
E-mail: prevailingwage@labor.mo.gov
Website: www.labor.mo.gov/DLS

<table>
<thead>
<tr>
<th>REQUESTER INFORMATION</th>
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<tbody>
<tr>
<td>I am requesting a wage determination according to Chapter 290 of the Missouri Prevailing Wage Law (sections 290.210 through 290.340 and 290.550 through 290.580 RSMo).</td>
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<tr>
<td>Name of Requester (please print)</td>
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<tr>
<td>Requester’s Organization</td>
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<tr>
<td>Mailing Address</td>
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<tr>
<td>City</td>
</tr>
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</table>

<table>
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<tr>
<th>PUBLIC BODY INFORMATION</th>
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<tr>
<td>Contact Person at Public Body</td>
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<tr>
<td>Official Name of the Public Body requesting the wage rates</td>
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<tr>
<td>Street Address</td>
</tr>
<tr>
<td>City</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FUNDING INFORMATION</th>
</tr>
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<tbody>
<tr>
<td>Will the federal government or any of its agencies furnish loans or grants for any part of the funds used in your contracts?</td>
</tr>
<tr>
<td>☐ Yes ☐ No</td>
</tr>
<tr>
<td>If “Yes,” will the federal government or any of its agencies also prescribe a schedule of Prevailing Wage Rates?</td>
</tr>
<tr>
<td>☐ Yes ☐ No</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>COUNTY(IES) REQUESTED</th>
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</thead>
<tbody>
<tr>
<td>Please list county(ies) requested:</td>
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<tr>
<td>(for St. Louis, please specify “County” or “City”)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANNUAL WAGE ORDER PASSWORDS</th>
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</thead>
<tbody>
<tr>
<td>The Annual Wage Order is being provided to requesters via the Division’s website. Passwords are required to access the Annual Wage Order and Incremental Increases on the Internet. Please provide an e-mail address below where we can send a password to you.</td>
</tr>
<tr>
<td>E-mail address:</td>
</tr>
</tbody>
</table>

Requester’s Signature ___________________________ Date of Request __________/________/_______
SECTION 008100 – PREVAILING WAGE DETERMINATION

PART 1 - GENERAL

1.1 This Project is contracted under the requirements of Missouri Prevailing Wage Law. This Section includes general information and forms for convenience. Detailed requirements, information, forms, and assistance may be obtained by contacting the following:

1. Missouri Department of Labor and Industrial Relations
   Division of Labor Standards
   Prevailing Wage Section
   PO Box 449
   Jefferson City, MO 65102-0449
   Phone: 573-751-3403
   Fax: 573-751-3721
   Email: prevailingwage@labor.mo.gov
   Website: www.labor.mo.gov/ls/prevailingwage

2. Contractor shall be responsible for obtaining the latest information and rates regarding the Missouri Prevailing Wage Law, including but not limited to incremental increases, issued on or before the date of bids.

B. Prevailing Hourly Rate of Wages: Not less than the prevailing hourly rate of wages, as set out in the wage order attached, must be paid to all workers performing work under this Contract.

1. Contractor shall forfeit a penalty to the contracting public body of $100 per day (or portion of a day) for each worker that is paid less than the prevailing rate for any work done under this Contract by the Contractor or by any Subcontractor.

2. Submit certified copies of Contractor’s and subcontractor’s payrolls to contracting public body on a weekly basis.

C. Safety Training Program: All on-site employees, including those of Contractor and subcontractors, are required to complete the ten-hour safety training program required under Section 292.675 RSMo, if they have not previously completed the program and have documentation of having done so.

1. Contractor shall forfeit a penalty to the contracting public body of $2500 plus an additional $100 for each employee, including those of subcontractors, for each calendar day, or portion thereof, such employee is employed without the required training.

D. Construction Transient Employers: Every transient employer, as defined in section 285.230 RSMo, must post in a prominent and easily accessible place at the site, a clearly legible copy of the notices listed below. Any transient employer failing to comply with these requirements shall, under section 285.234 RSMo, be liable for a penalty of $500 per day until notices are posted as required by the statute:

1. The notice of registration for employer withholding issued to such transient employer by the director of revenue.

2. Proof of coverage for workers’ compensation insurance or self-insurance signed by transient employer and verified by the Department of Revenue through records of the Division of Workers’ Compensation.

3. The notice of registration for unemployment insurance to such transient employer by the Division of Employment Security.

E. Posting of Wage Rates: While work under this Contract is being performed, a legible list of all prevailing wage rates must remain posted in a prominent and easily accessible location at the site by the Contractor and each subcontractor on the project. Such notice shall remain posted during the full time that any worker is employed on the project.


G. Project Completion Notification – Affidavit of Compliance: Before final payment will be made, the Contractor shall file a fully executed affidavit, PW-4 Form “Affidavit – Compliance with the Prevailing Wage Law”, available at www.labor.mo.gov/ls/prevailingwage under “Forms,” to The Division of Labor Standards (DLS).

H. Monthly Applications for Payment: Pursuant to prevailing wage laws, an Affidavit of Compliance (Form PW-4) must be filed with the District before payment will be approved. The District will withhold and retain any amounts due as a result of any violation of the prevailing wage law prior to making payment with any contractor. Include Affidavit of Compliance with each application for payment.

008100-1
PREVAILING WAGE
DETERMINATION
February 2018
PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 008100
1.1 Applicable Documents

A. E-Verify and E-Verify Addendum – All successful contractors are required to abide by the FEDERAL WORK AUTHORIZATION PROGRAM (“E-VERIFY”) and that each is required sign and return the enclosed affidavits attesting to that commitment. These affidavits shall be signed and returned to the Construction Manager as part of their start up documentation. Failure to comply with these requirements can in termination of the project agreement between the District and the Contractor.

B. Drug and Alcohol Testing Program - All successful contractors are required to have a random drug and alcohol testing program per State Statue for workers utilized to work on this project. Each contractor shall be required to sign and submit an executed copy of the CONTRACTORS AFFIDAVIT CONCERNING DRUG/ALCOHOL TESTING PROGRAM as part of their required start up documentation. Failure to comply with this requirement could result in termination of the project agreement between the District and the Contractor.

C. Felony Notification Program – All successful contractors are required to abide by the district’s Felony Notification Program if they wish to do business with the District. Each contractor shall be required to sign and submit an executed copy of the FELONY CONVICTION NOTIFICATION FORM as part of their required start up documentation. Failure to comply with this requirement could result in termination of the project agreement between the District and the Contractor.

D. PW-2 – Each contractor shall complete and submit a PW-2 form to the State as required by State law. A copy of this completed form shall be submitted to the Construction Manager as part of the project start up documentation.

E. Project Information Request & Subcontractor / Supplier List – Each Contractor shall fill out and submit these project forms to the Construction Manager as part of their start up documentation.
FEDERAL WORK AUTHORIZATION PROGRAM ("E-VERIFY") AFFIDAVIT FORM

I, ________________________, being of legal age and having been duly sworn upon my oath, state the following facts are true:

1. I am more than twenty-one years of age; and have first-hand knowledge of the matters set forth herein.

2. I am employed by __________ (hereinafter "Company") and have authority to issue this affidavit on its behalf.

3. Company is enrolled in and participating in the United States E-Verify (formerly known as "Basic Pilot") federal work authorization program with respect to Company’s employees working in connection with the services Company is providing to, or will provide to, the District, to the extent allowed by E-Verify.

4. Company does not knowingly employ any person who is an unauthorized alien in connection with the services the Company is providing to, or will provide to, the District.

FURTHER AFFIANT SAYETH NOT.

By: ________________________________ (individual signature)

For ________________________ (company name)

Title: _______________________

Subscribed and sworn to before me on this _____ day of ____________________, 20___.

_____________________________________________________

NOTARY PUBLIC

A. My commission expires: _____________________________________ ______
Pursuant to Missouri Revised Statute 285.530, all business entities awarded any contract in excess of five thousand dollars ($5,000) with a Missouri public school district must, as a condition to the award of any such contract, be enrolled and participate in a federal work authorization program with respect to the employees working in connection with the contracted services being provided, or to be provided, to the District (to the extent allowed by E-Verify). In addition, the business entity must affirm the same through sworn affidavit and provision of documentation. In addition, the business entity must sign an affidavit that it does not knowingly employ any person who is an unauthorized alien in connection with the services being provided, or to be provided, to the District.

Accordingly, your company:

a) agrees to have an authorized person execute the attached “Federal Work Authorization Program Affidavit” attached hereto as Exhibit A and deliver the same to the District prior to or contemporaneously with the execution of its contract with the District;

b) affirms it is enrolled in the “E-Verify” (formerly known as “Basic Pilot”) work authorization program of the United States, and are participating in E-Verify with respect to your employees working in connection with the services being provided (to the extent allowed by E-Verify), or to be provided, by your company to the District;

c) affirms that it is not knowingly employing any person who is an unauthorized alien in connection with the services being provided, or to be provided, by your company to the District;

d) affirms you will notify the District if you cease participation in E-Verify, or if there is any action, claim or complaint made against you alleging any violation of Missouri Revised Statute 285.530, or any regulations issued thereto;

e) agrees to provide documentation of your participation in E-Verify to the District prior to or contemporaneously with the execution of its contract with the District (or at any time thereafter upon request by the District), by providing to the District an E-Verify screen print-out (or equivalent documentation) confirming your participation in E-Verify;

f) agrees to comply with any state or federal regulations or rules that may be issued subsequent to this addendum that relate to Missouri Revised Statute 285.530; and

g) agrees that any failure by your company to abide by the requirements a) through f) above will be considered a material breach of your contract with the District.

By: _____________________________________________________________ (signature)

Printed Name: _________________________________________ Title:

___________________________________

For and on behalf of: __________________________________________________________(company name) ______________________________
Contractor's Affidavit Concerning Drug/Alcohol Testing Program

STATE OF MISSOURI

COUNTY OF

COMES NOW the Affiant after having first been duly sworn and testifies as follows:

My name is ___________________________ I hold the principal office of ___________________________

for ___________________________. I, the undersigned, being duly sworn, certify that ___________________________ is in compliance with the provisions of Missouri Revised Statute § 161.371; that ___________________________ has established and implemented a random drug and alcohol testing program as required by Missouri Revised Statute § 161.371 and any applicable regulations. I further certify that ___________________________ shall subcontract work only to subcontractors meeting the requirements of Missouri Revised Statute § 161.371.

________________________________________
Name of Contractor

________________________________________
Address

________________________________________
City

________________________________________
State

By: ______________________________________

Subscribed and sworn to before me this _____ day of _____________20___.

________________________________________
Notary Public

My Commission Expires: ________________________
FELONY CONVICTION NOTIFICATION FORM

The person or business entity that enters into an agreement with this school district must give advance notice to the District if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony.

The district may terminate this agreement with a person or business entity if the District determines that the person or business entity failed to give notice by the next preceding subsection, or misrepresented the conduct resulting in the conviction. The District will compensate the person or business entity for services performed before the termination of the agreement.

By submitting this offer and signing this certificate, this bidder:

- Certifies that the owner/operator has not been convicted of a felony, except as indicated on a separate attachment to this offer, and
- Certifies that no employee who will enter school buildings or potentially have contact with school children has been convicted of any felony or a misdemeanor involving violence or sexual contact or sexual abuse. It shall be the duty of the vendor to conduct the appropriate background checks on its employees and vendor agrees to share this information with the District upon request.

Vendor Name: ____________________________________________________________

Vendor Address: _______________________________________________________________________

Vendor E-mail Address: __________________________________________________________

Vendor Telephone: Fax Number: ____________________________

Authorized Company Official’s Name: ___________________________________________ (Printed)

Signature of Company Official: ____________________________________________

Date: __________________

Park Hill School District ATTACHMENTS 008400 - 5
Project No: 16111, 17088, 17097, 17115
February 18
AFFIDAVIT OF 10 HOUR OSHA TRAINING

Comes now ___________________________ as ___________________________ first
Name                                      Office Held
Being duly sworn, on my oath, affirm ___________________________ does
Company Name

comply with the requirements of Section 292.675, which requires all contractors and
subcontractors doing work on the project to provide, and require its on-site employees to complete
a ten-hour course in construction safety and health approved by the Occupational Safety and
Health Administration (OSHA) or a similar program approved by the Missouri Department of
Industrial Relations which is at least as stringent as an approve OSHA program.

In Affirmation thereof, the facts stated above are true and correct (The undersigned
understands that false statements made in this filing are subject to the penalties
provided under Section 292.675, RSMo).

_________________________________________  ___________________________
Signature (person with authority)          Printed Name

_________________________________________  ___________________________
Title                                      Date

Subscribed and sworn to before me this ________of______________________, 20 ____.

_________________________________________  ___________________________
Signature of notary                        Date
Please fill out the following information for the Park Hill Elementary School #11 project and return it to our office for project record.

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<th>Company Name:</th>
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**Project Manager Info:**
- **Name:**
- **Cell:**
- **EMAIL:**

**Field Superintendent/Manager:**
- **Name:**
- **Cell:**

**Submittal Coordinator(s) and/or Other Project Staff:**
- **Name:**
  - **EMAIL:**
  - **Phone:**
- **Name:**
  - **EMAIL:**
  - **Phone:**
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**Emergency Contact (if different than Project Manager):**
- **Name:**
- **Cell:**
- **EMAIL:**
## Subcontractor and Supplier List

<table>
<thead>
<tr>
<th>Spec Section</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Subcontractor / Supplier (name and address)</th>
<th>Phone</th>
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DOCUMENT 011000 - SUMMARY OF WORK

RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

Project Name: Park Hill – 2018 Summer Renovations

The Work: Complete work relating to the selective renovations to the following facilities.

- Park Hill High School – Administrative and Secure Entry Improvements, Renovations to the Media Center, Selective Carpet Replacement, and IT Infrastructure Improvements.
- Park Hill South - Administrative and Secure Entry Improvements, Renovations to the Media Center, Selective Carpet Replacement.
- LEAD Innovation Ctr - Buildout of 3 additional classrooms and associated renovations.
- Early Childcare Ctr - IT Infrastructure Improvements and Resinous Flooring
- Prairie Point Elem. - IT Infrastructure Improvements, New IT closets and Resinous Flooring

The work includes providing all labor, materials, equipment, supervision, accessories, appliances, hauling, storage, tools and incidents necessary for the construction and completion of the work according to the Contract Documents and Bid Packages.

Contract Documents indicate the work of the Contract and related requirements and conditions that have an impact on the project. Requirements and conditions that are indicated on the Contract Documents include, but are not necessarily limited to, the following:

1. Existing site conditions and restrictions on use of the site.
2. Coordination with existing work being performed under separate contracts.
3. Requirements for partial Owner occupancy prior to Substantial Completion of the Contract Work.

Summary by References: Work of the Contract can be summarized by references to the Contract, General Conditions, Supplementary Conditions, Specification Sections, Drawings, addenda, and modifications to the contract documents issued subsequent to the initial printing of the contract documents and including, but not necessarily limited to, printed material referenced by any of these. It is recognized that work of the Contract is also unavoidably affected or influenced by governing regulations and building codes.

PERMITS AND INSPECTIONS
Secure, schedule, coordinate and pay for all permits, licenses and inspections required by codes, ordinances, statutes, administrative regulations, national standards, etc., which bear on the Work. The Contract Documents list certain codes, etc., but such listing is not all inclusive. All contractors must obtain local business license.

Governing Building Codes and their editions intended to be used for this project are: As outlined in the plans and/or specifications.

CONTRACTOR USE OF PREMISES

General: The Contractor shall limit his use of the premises to the work indicated, so as to allow for Owner occupancy and use by the public.

Use of the Site: Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to the site rules and regulations affecting the work while engaged in project construction.

OWNER OCCUPANCY
Partial Owner Occupancy: The Owner reserves the right to place and install equipment as necessary in completed areas of the work to occupy such areas prior to substantial completion, provided that such occupancy does not substantially interfere with completion of work. Such placing of equipment and partial occupancy shall not constitute acceptance of work or any part of the work.

END OF DOCUMENT
011000

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SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.  
1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:
   1. Lump-sum allowances.
   2. Unit-cost allowances.

C. Related Requirements:
   1. Section 012200 "Unit Prices" for procedures for using unit prices.
   2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 LUMP-SUM AND UNIT-COST ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes (other than sales and use taxes), freight, and delivery to Project site.

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

1.7 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

A. General: Refer to individual Bid Package – Scopes of Work for Allowances.

END OF SECTION 012100
SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
   2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.2 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes (other than sales and use tax), overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Refer to Individual Bid Package – Scopes of Work.

END OF SECTION 012200
SECTION 012500  - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for “Substitutions for Convenience” and “Substitutions for Cause”.

B. Related Requirements:
   1. Section 012100 "Allowances" for products selected under an allowance.
   2. Section 012200 “Unit Prices” for products selected under a unit price.
   3. Section 012300 "Alternates" for products selected under an alternate.
   4. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
   5. Divisions 02 through 33 Sections for specific requirements and limitations for substitutions.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms. Substitutions for Cause, if any, shall be submitted after award of the contract as set forth hereinafter.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner. Substitutions for Convenience shall be submitted prior to bidding as set forth hereinafter.

B. Comparable Products: Naming of specified items on the Drawings and in the specifications, means that such named items are specifically required by the Architect and/or Owner. When the words “or comparable product” follows such named item(s), a substitution request must be submitted when proposing a product other than the named product. Requests for substitutions must be received by the Architect within the time frame set hereinafter.

C. The following are not considered substitutions:
   1. Revisions to Contract Documents requested by the Owner or Architect.
   2. Specified options of products, materials and construction methods included in the Contract Documents.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit at least one (1) paper copy or an electronic pdf copy of each request for consideration to the Architect. Clearly identify proposed product and all related options or fabrication or installation method to be replaced. Include Specification Section number and title, in addition to applicable Drawing numbers and titles.
   1. Substitution Request Form: Use facsimile of form provided at the end of this Section.
      a. Accompanying each Substitution Request shall be a fully executed copy of the Substitution Request Form.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
      b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
      c. A written and detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested of proposed substitution and of specified product shall be submitted for comparison and review by Architect.

f. Certificates and qualification data, where applicable or requested.

g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.

j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

k. Cost information, including a proposal of change, if any, in the Contract Sum.

l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.

m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Review Process: Submittal requests for proposed substitutions will be processed using the following procedures:

a. Submittals will be "Received Dated" immediately upon arrival.

b. Submittals will be placed by receiving person in a file designated for that purpose.

c. Submittals will not be reviewed for completeness or compliance until after the date and time established for closing of receipt of substitution request submittals.

d. Submittals will be reviewed by a member of Hollis + Miller Architect's staff (or respective consultant). Reviewer(s) will not be designated until after closing period established for receipt of submittal of substitutions.

e. Reviewer's General Attitude will be:

1) Burden of Proof is on Proposer.

2) Reviewer should not be required to complete the submittal, that is, select from options or between models and lines of products.

3) Reviewer should not be required to conduct an exhaustive review of the submittal. Submittals of manufacturer’s catalogs which do not clearly indicate proposed product and proposed product options will be rejected.

4) Reviewer should not be required to seek information from manufacturer's literature on file in the office, from an improperly submitted electronic submittal or information in other locations.

5) Substitute must be "comparable to" or superior in those features and performance which the Project requires and those which the specified product will provide.

6) Review is complete when, in the reviewer's opinion, significant deficiency(ies) are established. In such case, review of data covering other points of specifications is not required.

f. Reviewer will note action taken (No Exception taken to Submitted Manufacturer, No Exception taken to Specific Product, Exceptions Noted, Not Accepted or Received Late), the date, and his/her initials.

g. All submittals received after closing time will be "Received Dated", marked "Late", initialed by reviewer, and filed without review.

h. Submittals will be filed in Architect's office until completion of the Project.

4. Architect's Action:

a. Architect will review requests for “Substitutions for Convenience” only once, no additional information may be submitted. Architect may request additional information as necessary for review of “Substitutions for Cause.”

b. Architect will note action taken.

c. Architect is not obligated nor required to review any and all substitution requests.

d. Architect is not obligated to inform proposers of substitutions of incomplete and non-accepted requests for substitution.

e. Acceptance of Substitutions:

1) Acceptance of Substitutions for Convenience: Accepted substitutions will be set forth in an Addendum and in no other manner.

a) Use product specified if Architect does not issue a decision on use of a proposed substitution.
2) Acceptance of Substitutions for Cause: Architect will review proposed substitution within 15 business days of receipt of request. If necessary, Architect will request additional information or documentation for evaluation within seven (7) business days of receipt of a request for Substitution for Cause.” Only acceptable substitutions will receive notification of status. Substitutions shall be considered unacceptable unless a form of acceptance is received by the Proposer.
   a) Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b) Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 ELECTRONIC SUBMITTAL OF SUBSTITUTIONS

A. Substitution Request submittals will be accepted for review when submitted electronically under the following conditions. Substitution requests which are not submitted in accordance with the criteria listed below may be rejected at the Architect’s discretion.
   1. Accompanying each submittal shall be a fully executed copy of the Substitution Request Form.
   2. Submittals sent to Hollis + Miller Architects, shall be sent to person noted in Document 000101 - Project Team Directory. Submittals directed to the attention of anyone other than the person named above will not be considered.
   3. Submittals of Substitutions for Cause must be received within the time limits set forth in Paragraph 2.1 A of this Section.
   4. Submittals of Substitutions for Convenience must be received prior to bidding and within the time limits set forth in Paragraph 2.1 B of this Section.
   5. Documentation requirements as set forth in 1.3 A.2a through 1.3 A.2m are applicable to electronic submittals.
      a. Note: Electronic submittals in which the manufacturer’s entire catalog is submitted will be rejected.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor’s request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      b. Requested substitution provides sustainable design characteristics that specified product provided for achieving LEED prerequisites and credits.
      c. Request is directly related to a “or comparable product” clause or similar language in the Contract Documents.
      d. Specified product or method of construction cannot be provided within the Contract Time.
      e. Specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
      f. Specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution will provide the specified warranty.
      g. Substitution request is fully documented and properly submitted.
h. Requested substitution will not adversely affect Contractor's construction schedule.

i. Requested substitution has received necessary approvals of authorities having jurisdiction.

j. Requested substitution is compatible with other portions of the Work.

k. Requested substitution has been coordinated with other portions of the Work.

l. Requested substitution provides specified warranty.

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

B. Substitutions for Convenience: Architect will consider requests for substitution only when submitted prior to bidding, and no later than 4:00 p.m. (local time) eight calendar days prior to date established for receipt of bids.

Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

   a. Requested substitution 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.

   b. Requested substitution does not require extensive revisions to the Contract Documents.

   c. Requested substitution is consistent with the Contract Documents and will produce indicated results.

   d. Requested substitution provides sustainable design characteristics that specified product provided for achieving LEED prerequisites and credits.

   e. Substitution request is fully documented and properly submitted.

   f. Requested substitution will not adversely affect Contractor's construction schedule.

   g. Requested substitution has received necessary approvals of authorities having jurisdiction.

   h. Requested substitution is compatible with other portions of the Work.

   i. Requested substitution has been coordinated with other portions of the Work.

   j. Requested substitution provides specified warranty.

   k. 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.

C. The Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptance or validate request for substitution, nor does it constitute approval.

D. Under no circumstances does the Architect's and/or Owner's acceptance of any such substitution relieve the Contractor from timely, full and proper performance of the Work.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500
SPECIFIED ITEM: _____________________________________________________________

PROPOSED SUBSTITUTE: _______________________________________________________

SUBMITTED BY:

Firm: ___________________________________________________________
Address: ___________________________________________________________
Signature: ___________________________________________________________
Date: _______________ Phone No. ___________________ Fax No. _______________

Attach complete description, designation, catalog or model number, Spec Data Sheet and other Technical Data and samples, including Laboratory Tests if Applicable.

Fill in blanks below:

1. Will substitution affect dimension indicated on drawings? _____________________________

2. Will substitution affect wiring, piping, ductwork, etc., indicated on drawings? _____________________________

3. What effect will substitution have on other trades? _____________________________

4. Differences between proposed substitution and specified item? _____________________________

5. Any and all impacts on costs, design modifications, additional architectural and engineering services, material and labor changes, schedule changes, and other unanticipated consequences, resulting from this substitution in lieu of the specified item, shall be the full responsibility of the contractor and his subcontractors and supplier.

6. Manufacturer’s warranties of the specified items and proposed items are: [ ] same [ ] different, explain: _____________________________

REVIEW COMMENTS:

[ ] No Exception taken to Submitted Manufacturer
Manufacturer only is accepted due to time limitations for full review of product, or because no specific product data is submitted, or other unspecified reasons. Contractor must still bear full responsibility for compliance with contract requirements.

[ ] No Exception taken to Specific Products

[ ] Exceptions Noted
See attached copy or notes on product literature

[ ] Not Accepted

[ ] Received too Late

By:_____________________________ Date:________________________

Remarks:__________________________________________________________
DOCUMENT 012600 – CONTRACT MODIFICATION PROCEDURES

Section Index
012613 – Request for Information (RFI’s)
012636 – Supplemental Instructions
012639 – Field Orders
012646 – Construction Change Directives
012653 – Proposal Requests
012663 – Change Orders

I. Section 012613 – Request for Information (RFI)
   A. General: If during the construction of the Project, clarification of the Documents is required, it shall be brought to the attention of the Construction Manager.
   B. Contractor shall prepare and submit to the Construction Manager an RFI electronically via Procore
   1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
   2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
      a. RFIs will not be considered asked until submitted in the manner indicated in this section.
   C. The Procore Form for the RFI: Shall be completed and Include the following information.
      1. RFI subject.
      2. Specification Section number and title and related paragraphs, as appropriate.
      3. Drawing number and detail references, as appropriate.
      4. Field dimensions and conditions, as appropriate.
      5. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
      6. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
         a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
   D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow an average of seven calendar days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.
   E. The following RFIs will be returned without action:
      1. Requests for approval of submittals.
      2. Requests for approval of substitutions.
      3. Requests for coordination information already indicated in the Contract Documents.
      4. Requests for adjustments in the Contract Time or the Contract Sum.
      5. Requests for interpretation of Architect's actions on submittals.
      6. Incomplete RFIs or inaccurately prepared RFIs.
   F. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
   G. On receipt of Architect's and Construction Manager's action, immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven calendar days if Contractor disagrees with response.
   H. Responses to RFIs are not authorization to proceed with work requiring additional compensation

II. Section 012636 – Supplemental Instructions
   A. Architect will issue, through Construction Manager, supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, these issues will be on Architect Form (ASI) and issued electronically as a PDF to
Contractors.
1. Should for any reason Contractor feel that an ASI involves an adjustment of contract sum or time then they should submit notice of such to the Construction Manager within 48 hours after issuance of ASI so that further direction can be given.

III. **Section 012639 – Field Orders**
A. The Owner, through the Construction Manager may issue field directed changes in the Work, not involving adjustment to the Contract Sum or the Contract Time. Field Orders will be on the Construction Manager’s Form.

IV. **Section 012646 – Construction Change Directives**
A. Construction Change Directive: Construction Manager, with Architect’s concurrence, may issue a Construction Change Directive instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
B. 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.
C. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. Each Construction Change Directive will be signed by the Owner, the Architect and the Construction Manager.
D. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
E. Construction Change Directive Form: Will use form selected by the Construction Manager

V. **Section 012653 – 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.
B. Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
C. Within time specified in Proposal Request, or 10 calendar days when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change. If the Proposal Request is not received within 10 calendar days by the Construction Manager, the cost will be determined by a third party cost estimator using localized industry pricing standards, whether the cost of the work is an Add or Deduct.
   1. 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.
   2. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   3. Include costs of labor and supervision directly attributable to the change.
   4. 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.

VI. **Contractor-Initiated Proposals:** If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.
A. 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.
B. 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.
C. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
D. Include costs of labor and supervision directly attributable to the change.
E. 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.
F. Comply with requirements in Division 1 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
G. Proposal Request Form: Use AIA Document G709, "Proposal Request" or similar form approved by Construction Manager.
H. The Construction Manager will review the pricing with the Owner and Architect to determine if a Change Order will be issued. Contractors are not to proceed with additional work until written authorization has been received.

VII. Section 012663 – Change Orders
A. If the Owner determines that a Proposal Request or a Request for Information involving and change in Contract time or in Contract Sum will be accepted, the Construction Manager will prepare a Change Order (CO) which will be dated and numbered sequentially. The Change Order will: describe the change or changes, will refer to the Proposal Request and proposal number, or Request for Information. Each Change Order will be signed by the Owner, the Architect, and the Construction Manager.
B. Change Order Form: Will use Form Selected by Construction Manager and Owner. Form will include the following:
   1. Title
   2. Description of Change
   3. Previous Contract Amount
   4. Value of Change
   5. Updated Contract Amount
   6. Changes to Contract Time
C. Mark up for directed work:
   1. Self-perform work 10% for overhead and profit
   2. Subcontract work for 5% overhead and profit
   3. The rate apply to all sub tier contractors and suppliers

VIII. Back Charge Change Orders
A. General
   1. In numerous places throughout the contract documents, it refers to contractors taking steps to protect their own work while it is being put in place as well as protecting their work after it is in place until substantial completion. The Contract Documents also require contractors to take measures to protect the work of other contractors who have by construction sequence, or driven by schedule have placed their work ahead of another contractor.
B. From time to time during the construction of the project the Owner and Construction Manager are faced with contractor back charges & claims from the Owner to a Contractor or one Contractor to another for, additional work as a result of noncompliance to contract, perceived damages to their work or failure to clear materials out of the others ways, etc. When these type claims occur they will be addressed under the following format.
   1. Back Charge Claims will need to be filed with the Construction Manager within 14 days from occurrence.
   2. Contractor filing Claim will need to file detailed information to support the claim, including a complete material and labor break down, Photographs of damages and provide supporting evidence that the damages is the fault of specific Contractor.
   3. Filing Contractor will also need to provide a copy of above documents to Contractor(s) they are claiming against.
C. Claim Review Process
   1. When such claims are presented to the Construction Manager, the Construction Manager will ask all contractors involved in the claim to present their positions on the matter. This
information will then be reviewed by the Owner, Architect and Construction Manager and a final determination of fault will be accessed.

2. Once the Determination of Fault has been established, the Owner, Construction Manager and Architect will review cost information provided and determine an appropriate value to be assessed.

3. Once these determinations have been made the Construction Manager will issue a Back Charge Change Order and Contract adjustments will be made accordingly to the respective contracts. This Back Charge Change Order will require only the signature of the Construction Manager, the Architect and the Owner to become final and effective, the signature of the Contractor will be optional.

D. Appeal of Back Charge Determination
   1. Contractors wishing to further dispute the Back Charge Change Order may seek additional measures outlined in the contract documents.
DOCUMENT 012900 – PAYMENT PROCEDURES (CM)

SECTION INDEX

012973 – Schedule of Values
012976 – Progress Payment Procedures

012973 – SCHEDULE OF VALUES

I. GENERAL
   A. Prior to the first application for payment each separate contractor shall present to the Construction Manager for approval an expanded schedule of values which will define labor and material separately for each portion of the work to be performed.
   B. Upon request of the Construction Manager, the contractor shall support the values with data which will substantiate their correctness.
   C. The Schedule of Values, unless objected to by the Architect, shall be used only as the basis for the Contractor's Applications for Payment.

II. FORM AND CONTENT OF SCHEDULE OF VALUES
   A. Submit schedule on AIA Document G703 or Similar Form approved by the Construction Manager; Contractor's standard forms and automated printout will be considered for approval by the Construction Manager upon Contractor's request.
   B. Building Contract Work will be organized by phase as laid out in the project phasing plan. Within each phase, breakdown the costs of your work by specification section. The more detailed your schedule of values, the easier it is for us to evaluate your pay applications.
   C. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
   D. Follow the table of contents of the Project Manual as the format for listing component items. Identify each line item with the number and title of the respective major section of the specifications.
   E. For each major line item list sub-values of major products or operations under the item.
   F. Break each item out per Labor and Material.
   G. Submit a sub-schedule for each separate stage of work specified.
   H. Submit a sub-schedule of unit costs for Products specified under a unit cost allowance.
   I. The sum of all values listed in the schedule shall equal the total Contract Sum.
   J. Where line items are for materials or work that is by subcontractors or suppliers, identify those line items in parenthesis with (subcontract) or (supplier)

012976 – PROGRESS PAYMENT PROCEDURES

I. GENERAL
   A. Each contractor shall submit Applications for Payment to the Construction Manager for his review and recommendations to the Architect and Owner in accord with the schedule established by conditions of the Contract and Agreement between the Owner and the Contractor.
   B. Each separate Contractor shall submit to the Construction Manager, along with his pay applications a Contractor's, Subcontractors, Sub-Subcontractors and Suppliers Affidavit and Waiver of Lien that all labor (to include Union Benefits) and materials have been paid through the previous applications, as well as a conditional release of lien for the current application being submitted.
   C. Submit itemized applications typed on AIA Document G732 or pre-approved Electronic Application and Certificate for Payment, and continuation sheets, AIA Document G703.
   D. Submit as part of the pay application a monthly updated work schedule as required in Section 013216.
   E. Submit as part of the pay application a copy of all Daily Reports as required in Section 013226.
   F. Failure to submit any of the required items may result in pay application's being held until submissions are complete.
G. Submit Certified Payroll showing compliance with the prevailing wage laws of the State of Missouri Reference Section 008100.

II. PREPARATION OF APPLICATION
A. Application Form:
   1. Fill in required information, including that for Change Orders executed prior to the date of submittal of application.
   2. Fill in summary of dollar values to agree with the respective totals indicated on the continuation sheets.
   3. Executed Notarized Certification with the Signature of a responsible officer of the contractor firm.
B. Continuation Sheets
   1. Fill in total list of all scheduled component items of work, with their item number and scheduled dollar value for each.
   2. Fill in the dollar value in each column for each scheduled line item when work has been performed or products presently stored on site.
   3. List each Change Order fully executed prior to date of submission, at the end of the continuation sheets unless otherwise agreed upon.
   4. List each Change Order Number, and description for each component item of work.
C. SUBMITTAL PROCEDURE
   1. Submit in accordance to Section 007300 Supplementary General Conditions.

END OF DOCUMENT
012900
I. **013113 – PROJECT COORDINATION**

A. **COORDINATION**

1. Coordinate scheduling, submittals and Work of the various sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements.

2. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

3. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

4. In finished areas, conceal pipes, ducts and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

5. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

6. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner’s activities.

B. **EXAMINATION**

1. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

2. Verify that existing substrate is capable of structural attachment of new Work being applied or attached.

3. Examine and verify specific conditions described in individual specification sections.

4. Verify that utility services are available, of the correct characteristics, and in the correct location.

C. **PREPARATION**

1. Clean substrate surfaces prior to applying next material or substance.

2. Seal cracks or openings of substrate prior to applying next material or substance.

3. Apply any manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

D. **VERTICAL & HORIZONTAL PENETRATIONS & SLEEVES**

1. Each Contractor is responsible for the layout, placement and identification of all
necessary sleeves or penetrations needed to complete his work.
2. All penetrations or sleeves are to be fire stopped and sealed water tight prior to completion of the contractors work.
3. All vertical sleeves or penetrations are to extend one and one half inches (1 ½”) above the floor, slab, or house-keeping pad and be sealed water tight.
4. It will be the responsibility of the Contractor installing the penetration or sleeve to ensure the penetration is water tight upon completion of work.

II. 013119 – PROJECT MEETINGS
A. Descriptions
1. The Construction Manager shall schedule and administer, pre-construction meetings, progress meetings and specially called meetings throughout the course of the project as he deems necessary to satisfactorily accomplish the work.
2. Representatives of contractors, subcontractors and suppliers shall be qualified and have the authority to act on the behalf of the entity each represents.
3. Contractors and/or Suppliers working on the project, or contractors and/ or suppliers notified and requested to attend the meetings will be required to be in attendance at each meeting, unless other preapproved arrangements have been made with the Construction Manager. Contractors missing meeting without having made prior arrangements may be fined \$200.00 per meeting missed. This money will be deducted by change order to contract. All Contractors by signing their contract give automatic approval of the missed meeting fine as a term and condition of their contract.

B. PRE-CONSTRUCTION MEETING
1. Will be scheduled prior to Contractor starting work on project.
2. Location & Time: Construction Manager will determine best time and location for meeting to take place.
3. Attendance:
   a. Construction Manager
   b. Architect & Consultants
   c. Contractors as appropriate to agenda
   d. All Sub Contractors of Contractor
   e. Suppliers as appropriate to agenda
   f. Others as deemed appropriate by Construction Manager or Architect

C. WEEKLY FOREMAN’S MEETINGS
1. The Construction Manager will schedule weekly foreman’s meetings or specially called meetings as necessary to satisfactorily accomplish the work.
2. Location and Time: Will be established by the Construction Manager.
3. At these meeting each contractors foreman is to provide to the Construction Manager a weekly progress schedule showing what work was accomplished in the prior week and the work scheduled for the next two following weeks, in addition each contractor can bring up any coordination or others items that are affecting his work.
4. Attendance:
   a. Construction Manager – Field Manager
   b. Foreman for all Contractors presently working on site - Field Managers
   c. Other Contractors as deemed appropriate by Construction Manager
   d. Suppliers as deemed appropriate by the Construction Manager

D. PROJECT MANAGER JOB PROGRESS MEETINGS
1. The Construction Manager will schedule progress meetings or specially called meetings as necessary to satisfactorily accomplish the work. Contractor should expect not less than 1 meeting per month.
2. Location and Time: Will be established by the Construction Manager.
3. Twenty-four (24) hours prior to the meeting, each Contractor is to provide to the Construction Manager a weekly progress schedule showing what work was accomplished in the prior week and the work scheduled for the next two following weeks, in addition each contractor is to submit any agenda items they feel need to be added to the agenda.
4. Attendance:
   a. Construction Manager – Project Manager
   b. Construction Manager – Field Manager
   c. Architect and Consultants (only if required for special circumstance)
   d. All Contractors presently working on site - Project Managers
   e. A contractor whose work is set to commence on site within 4 calendar weeks of meeting date.
   f. Other Contractors as deemed appropriate by Construction Manager
   g. Suppliers as deemed appropriate by the Construction Manager

E. PROJECT TEAM MEETINGS
1. The Construction Manager will schedule progress meetings or specially called meetings as necessary to satisfactorily accomplish the work.
2. Location and Time: Will be established by the Construction Manager.
3. Forty Eight (48) hours prior to the meeting, each Contractor is to provide to the Construction Manager a weekly progress schedule showing what work was accomplished in the prior week and the work scheduled for the next two following weeks, in addition each contractor is to submit any agenda items they feel need to be added to the agenda.
4. Attendance:
   a. Construction Manager – Project Manager
   b. Construction Manager – Field Manager
   c. Architect and Consultants
   d. School Board / Owner representative(s) as desired
   e. Other Contractors as deemed appropriate by Construction Manager (for specific issues only)
   f. Suppliers as deemed appropriate by the Construction Manager (for specific issues only)

III. 013126 – ELECTRONIC COMMUNICATIONS
A. GENERAL
1. Procore will be used on this project for Submittals, RFI's, Closeout, Project Documents / Changes, Coordination, and additional items as determined by the Construction Manager.
2. Contractors responsible for having a knowledgeable person on staff that can create, upload, download, etc. PDF Files.
3. Construction Manager will provide a training session for any contractor not familiar with this system at the start of the project.

END OF DOCUMENT
013100
I. 013213 – SCHEDULING OF WORK
A. Contractor Requirements
1. Schedule their work in accordance with the Construction Schedule, and in coordination with the Construction Manager.
2. Planning so that all tools, equipment, materials, labor, etc. necessary to complete their work are readily available prior to the scheduled start time for their work.
   a. Contractors will be held responsible for any and all costs associated with delays caused as a result of their ineffective planning. This includes cost to accelerate other trades as necessary to make up for lost time.
3. Contractors are responsible for attending Project Meetings, Foreman Meetings, and Reviewing the updated Schedule to determine any changes needing to be made to their Schedule.
4. Contractor will incorporate such changes into their Schedule

B. Construction Manager Requirements
1. Construction Manager will create an Overall Project Schedule based on durations given with Contractor’s Bid and Contractor’s Approved Schedules submitted.

II. 013216-CONSTRUCTION SCHEDULE

Overall Project / Construction Timeline:
a. Anticipated Start date – May 29, 2018
b. Anticipated Completion date - August 1, 2018
   i. Each trade is required to submit durations for their portions of the work in order to achieve this schedule.
   ii. Dates are current projections and shall be adjusted based upon contractor feedback provided at bid time. Actual project dates will be confirmed via composite master schedule created from bidding contractors bid durations.

A. The Contractor shall, within 15 days after Notice to Proceed or Award of Contract, whichever comes first, prepare and submit to the Construction Manager for approval, a detailed time line work schedule, showing the order in which the Contractor proposes to carry on the work and the time at which the several salient features will be started and completed. Schedules shall be based on the dates listed in the forthcoming Construction Manager’s “Construction Milestone Schedule. Schedules should also include durations and labor/crew size for these activities and phasing of the Work.
1. Each Contractor shall incorporate into his analysis that work being performed by each subcontractor so that all work involved is shown in the schedule for the complete Project.
2. Activities shown on the schedule shall consist not only of the actual construction operations, but will include also the submittal of shop drawings and samples, procurement of materials and equipment and installation and testing of major and critical items.
3. Each Contractor's schedule, as a minimum, shall provide for:
   a. Long lead team procurement activities.
   b. Contact phasing activities.
   c. Activation and testing activities.
   d. Milestone dates for contract phasing requirements.
   e. Owner furnished equipment rough-ins/deliveries.
   f. Utility tie-in activities.
g. Cleanup and punch list activities and Owner move-in activities.
h. The project shall be broken down into logical building areas by floor levels, elevations, functional spaces, an addition or renovation, etc.
i. Concurrent work activities.
j. Shop drawing, submittals and approvals.
k. Weather constraints.

4. Related activities shall be grouped on the schedule for simplification. The selection of activities will be subject to approval by the Construction Manager.

5. For each activity there shall be listed an earliest and latest start time, the earliest and latest finish time and the float time.

6. During progress of the work, any changes in the original schedule desired by the Contractor which affect contract completion dates must be approved by the Construction Manager before being put into effect.

B. From this information the Construction Manager shall develop a construction schedule using the critical path method, precedence schedule for the overall project. Contract times and completion dates shall then be adjusted accordingly at no additional cost to the Owner. Schedule information will be requested in a similar format and breakdown as the Schedule of Values. Schedule information shall include shop drawing submittal schedule, material delivery schedule, and construction activity information.

1. The Work in this Contract shall be commenced and completed pursuant to the Project Master Schedule of construction developed by the Construction Manager, and as amended from time to time. The Contractor recognizes that revisions in the Project Master Schedule as prepared by the Construction Manager are inherent in the nature of construction, which may result in revisions of the Contractor’s schedule of the Work during the progress of Construction. The Contractor agrees that the Construction Manager cannot guarantee that the Contractor can start work on any particular date or continue without interruption once started.

C. This Contractor shall work with the Construction Manager to develop an overall project schedule, meeting the Milestone Schedule. This Contractor shall coordinate their Work with the major construction activities identified in the Milestone Schedule. When it becomes apparent from the “updated” short term schedule that any activity completion date may not be met, the responsible Contractor shall take some or all of the following actions, at no additional cost to the Owner.

1. Increase construction manpower in such quantities that will substantially eliminate the slippage of work and put the project back on schedule.
2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the aforementioned as will substantially eliminate the slippage of work and put the project back on schedule.
3. Reschedule activities to achieve maximum practical concurrence of accomplishment of activities and put the project back on schedule.
4. If the Contractor fails to take any of the actions within forty-eight (48) hours after receiving written Notice, the Construction Manager shall take action to attempt to put the project back on schedule and deduct the cost of such actions from the monies due to become due the Contractor.

D. Monthly Schedule Updates: Contractor shall submit to the Construction Manager monthly schedule updates and narrative reports to include current status of the Work, problem areas, current and anticipated delaying factors (including outstanding RFI’s and submittals), and their estimated impact on performance of other activities and completion dates. Include with the above an explanation of corrective action taken and proposed solutions.

1. Submit Monthly Schedule Updates with Applications for Payment
   a. Applications for Payment will not be processed until these are received.
2. Schedule Slippage: The Contractor shall identify any schedule slippage at each month update and identify reasons why.
E. Shop Drawing Submittal Schedule: Submit with this Contractor’s schedule information, a bar-
chart schedule, and tabulation by date, the submittals required by the contractor’s Work.
Information included in this schedule shall be as described in specification section 01300, Part
1.4.

F. When changes in the work are required and directed by the Owner and Architect under
applicable paragraphs of this Contract, the original schedule shall be revised without delay to
incorporate such changed or new work and indicate the effect thereof on the Project as a whole.
The cost of such schedule change shall be considered as part of the cost of revised work.

G. Each Contractor shall remain on schedule as directed by the Construction Manager. In the
event the Contractor falls behind the progress schedule, due to actions and/or inactions
controlled by the Contractor, the Contractor shall take such steps as may be necessary to
improve his progress, which may require him to increase the number of shifts, and/or overtime
operation, days of work and/or the amount of construction plant, and to submit for approval
revised schedules in the form above in order to demonstrate the manner in which the agreed
rate of progress will be regained, all without additional cost to the Owner.

H. Failure of the Contractor to substantially comply with the schedule or to develop a recovery
schedule may be considered grounds for a determination by the Owner, pursuant to Article 14
that the Contractor is failing to prosecute the work with such diligence as will ensure the
completion of the work within the time specified.

I. If additional costs are incurred by subsequent trades to recover the project schedule,
the Contractor responsible for the delay will be responsible for that trade Contractor’s
additional costs.

III. 013226-CONSTRUCTION PROGRESS REPORTING
A. Each Contractor or Subcontractor shall submit to the Construction Manager, Daily Reports,
wherein the following data is provided relative to his Work and the Work of his
Subcontractors:
1. Location and description of work being performed.
2. Problems, if any, encountered during the course of the day's work.
3. Number of personnel on job for Contractor and each Subcontractor (broken down as to the
number of journeymen, apprentices, etc.).
4. Temperature and weather conditions.
5. Discrepancies, if any, noted in Plans and Specifications.
6. Report any accident or accidents that may have occurred during the reporting period.
7. These reports may be turned in on a weekly basis, but must be turned in to Construction
Manager prior to Pay Application or processing of Pay application will be held up pending a
full submission as required in Section 012900.

END OF DOCUMENT
013200
SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:
   1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
   2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
   3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   5. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.


1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
      a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
   4. Format: Arrange the following information in a tabular format:
      a. Scheduled date for first submittal.
      b. Specification Section number and title.
      c. Submittal category: Action; informational.
      d. Name of subcontractor.
      e. Description of the Work covered.
      f. Scheduled date for Architect's and Construction Manager's final release or approval.
      g. Scheduled date of fabrication.
1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor, at a nominal cost, for use in preparing submittals.

   a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
   b. Digital Drawing Software Program: The Contract Drawings are available in Revit (latest version) using Windows 10 operating system.
   c. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.

B. General:

1. Submittals shall be neat and legible, of uniform scale matching contract Documents, with all sheets of similar information of same size.
2. Electronic copies of CAD Drawings of the Contract Drawings may be provided by Architect for Contractor, at a nominal cost, subject to the requirements of Section 017839 “Project Record Documents.”

C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of 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 and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. It is expected that all submittals will be submitted within the durations outlined in the bid form as provided by each trade.
   a. A $100.00 per calendar day penalty will be assessed for any submittal received after durations received as provided by each trade. The penalty will be deducted from the contract through deductive change order. Only if written authorization from the Architect to extend this time frame can this “per day” penalty not be enforced.
   b. The completion time of the contract will not be extended for delays caused by tardiness of submittals. Cost of such delays shall not be borne by the Owner and may be back-charged as necessary.
      1) Contractor shall assume full responsibility for providing materials as specified at their risk to maintain schedule if submittals are not submitted within durations provided on the bid form.
   c. Upon receipt of unapproved submittals, Contractors will have seven (7) calendar days to revise and resubmit. After such time, the penalty outlined above in 1.4.C.1.a will be assessed.
2. Initial Review: Allow 14 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.
3. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
4. Resubmittal Review: Allow 7 days for review of each resubmittal.
5. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 days for initial review of each submittal.
6. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Construction Manager, through Architect, before being returned to Contractor.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., PHMS-079200.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., PHMS-079200.01.A).
b. Specific material/product identifier: After listing the project identifier and section number as described above, clearly indicate the material/product submitted corresponding to specific paragraph in the specification (e.g., Silicone Joint Sealant – 2.2 A).

3. Provide means for insertion to permanently record Contractor’s review and approval markings and action taken by Architect and Construction Manager.

4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software or electronic form acceptable to Owner, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect and Construction Manager on previous submittals. Indicate by highlighting on each submittal and noting on attached separate sheet, prepared on Contractor’s letterhead.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect’s and Construction Manager’s action stamp.

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

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect’s and Construction Manager’s action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. Forward all submittals accompanied by completed transmittal form to the Construction Manager who shall review and approve all submittals prior to transmitting approved transmittals to the Architect.
1. Procore will be used for submitting submittals, as such, all submittals shall be submitted in the form of a PDF file.
   a. Along with the PDF file, contractors will be required to submit to the Construction Manager, one (1) full size hard copy of shop drawings for review and approval as deemed necessary by the Construction Manager.
   b. After approval of shop drawings, Contractors will be required to submit to the Construction Manager, one (1) full size hard copy of the approved Shop Drawings.

B. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project.
   2. Submit electronic submittals via email as PDF electronic files. Electronic submittal files which are too large to distribute via email, shall be sent individually and numbered sequentially.
      b. Along with the electronic submittal, Contractor shall submit to the Architect, one (1) full sized hard copy of each shop drawing for review and approval, as deemed necessary by the Architect.
      c. Along with the electronic submittal, contractors shall submit to the Construction Manager, one (1) color deck or color card for each submittal requiring color selection for review, approval and color selection, as deemed necessary by the Architect.
   3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
      a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
      b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

C. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to clearly show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.
   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams showing factory-installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
   5. Submit Product Data before or concurrent with Samples and Shop Drawings, as applicable.
   6. Submit Product Data in the following format:
      a. PDF electronic file according to Paragraph 2.1.A.1.

D. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

3. Submit Shop Drawings in the following format:
   a. PDF electronic file according to Paragraph 2.1.A.1.

4. 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.
   1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   2. Identification: Attach label on unexposed side of Samples that includes the following:
      a. Generic description of Sample.
      b. Product name and name of manufacturer.
      c. Sample source.
      d. Number and title of applicable Specification Section.
      e. Specification paragraph number and generic name of each item.

5. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Samples for “initial selection” shall be listed as a separate item in the submittal schedule.
   b. Number of Samples: Unless specifically required otherwise in Specification Section, Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.

8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

9. Electronic Transmittal: Provide PDF transmittal for all physical Samples. Include digital image file illustrating Sample characteristics, and identification information for record.

F. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.
   5. Submit product schedule in the following format:
      a. PDF electronic file.
G. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

H. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

I. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

J. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

K. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

L. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

M. LEED Submittals: Comply with requirements specified in Section 018113 "Sustainable Design Requirements – LEED v4 BD+C."

N. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

O. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

P. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

Q. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

R. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

S. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

T. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

U. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

V. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   1. Name of evaluation organization.
   2. Date of evaluation.
   3. Time period when report is in effect.
   4. Product and manufacturers' names.
   5. Description of product.
   6. Test procedures and results.
   7. Limitations of use.

W. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard
form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

X. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency’s standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

Y. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Z. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file in addition to three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR’S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, 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 AND CONSTRUCTION MANAGER’S ACTION

A. General: Architect will not review submittals that do not bear the Contractor’s approval stamp and will return them without action.

B. Action Submittals: Contractor is responsible for conforming and correlating dimensions at job sites for tolerances, clearances, quantities, fabrication processes, coordination of the Work with multiple trades, and full compliance with the Contract Documents. The Architect will review submittals for general conformance with the Contract Documents. Architect and Construction Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. No Exception Taken: Signifies item represented in the submittal conforms with the design intent, complies with the intent of the Contract Documents and is acceptable for incorporation into the Work. Contractor is to proceed with fabrication or procurement and related work.
2. Exceptions Noted: Signifies item represented in the submittal conforms with the design concept, complies with the intent of the Contract Documents and is recommended for incorporation into the Work in accordance with the Architect’s and/or Consultant’s notations. Contractor is to proceed with the work in accordance the Architect’s and/or Consultant’s notations marked on the returned submittal or letter of transmittal. Resubmittal is not required.

3. Revised and Resubmit: Signifies item represented in the submittal appears to conform with the design concept and comply with the intent of the Contract Documents, but information is either insufficient or contains discrepancies which prevent the Architect and/or his Consultant from completing his review. Contractor is to resubmit revised information. Fabrication or procurement of the item and related work is not to proceed until the submittal is acceptable.

4. Not Accepted: Signifies item represented in the submittal does not conform with the design concept or comply with the intent of the Contract Documents and is not recommended for incorporation into the Work. Contractor shall submit items responsive to the Contract Documents.

C. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300
I. CONTRACTOR'S RESPONSIBILITY
   A. Each Contractor is responsible for the quality of the work performed by his work force and subcontractors as well as the quality of the material, equipment and supplies furnished by the Contractor to be incorporated into the work. Contractors shall designate a quality control representative who will be onsite at all times when work is in progress.
   B. Contractors will be responsible for submitting to the Construction Manager their Project Specific Quality Control Plan for the project. Construction Manager with the help of the Design Team and Owner will review the Contractors Quality Control Plan. Contractors may be required to make adjustments to their Quality Control Plan based on Construction Manager's, Design Team, and Owner feedback. At a Minimum all Quality Control Plan's should contain the following Information. However additional information may be required depending on the scope of the project.
      1. Cover Sheet with Name of Project, Contractor, Construction Manager, Architect, and Owner. As well as author of the plan and date submitted.
      2. List of Contractor's Primary Personal with contact information (Email and Phone Number) including. Project Manager, Quality Control Manager, Superintendent, Foreman, Safety, and any other necessary contacts.
      3. Resumes and Certifications of Contractors Personal
      4. Responsibility of Personal for the project and their authority level.
      5. List of Contractor's Schedules which list the type, quantity, etc. for the following items.
         a. Submittals
         b. Pre-installation Meetings
         c. Materials, include a list of QC inspections for each material (ie. Material, Preinstall, Initial, Follow-up, final).
            i. Include list of Materials that are required to be coordinated with, embedded in or require openings in other Contractor's work and list of information needed for proper coordination.
         d. Owner Furnished Materials that affect the installation of Contractor's work and information needed for coordination
         e. Special Inspections
         f. Mockup's
      6. Blank copies of Contractor's Quality Control Forms which include but are not limited to the following. Note that these forms will be required to be completed by the Contractor and submitted to the Construction Manager with the Contractors Daily Log. Instructions for completing forms and inspections should be included.
         a. Material Inspection Forms – for inspection of materials upon receipt.
         b. Pre-Installation Inspection Forms – for inspection of substrate, existing conditions, etc.
         c. Initial Inspection Forms – for inspection of work in place after approximately 5 to 10% of work is installed.
         d. Follow Up Inspection Forms – when necessary the quantity of the work may require secondary inspections for various percentages complete (ie. 25%, 50%, 75%, etc.).
         e. Final Inspection Forms – for inspection of work upon completion.
      7. This plan should be submitted within 30 Calendar Days from Notice to Proceed
         a. In the even that Contractor's work is taking place that the 30 Calendar Days puts the submission of this plan after the start of work, then such plan should be submitted within 7 Calendar days from start of Contractor's work.
   C. The Owner will pay for initial tests for concrete, steel, masonry and soil. When initial tests indicate noncompliance, additional testing shall be performed by the same testing agency and the costs of such testing shall be paid by the Contractor.
   D. Each Contractor shall arrange and pay for all inspections and tests specified as the Contractor's responsibility in the various sections of the Specifications; in addition to any inspections and tests performed for the Contractor's convenience. These tests shall be made by an independent testing agency approved by the Owner.
   E. Each Contractor shall advise the Construction Manager's on-site representative of all scheduled
tests. The Contractor’s quality control representative will review his drawings, procurement documents and contracts to ensure that the technical information provided and all work performed is in accordance with the latest revision of the Contract Documents.

1. Contractors shall maintain a complete set of original contract documents, including contract drawings and specifications, on site for the work performed under his contract. These documents shall be updated to reflect all changes made through Addenda, Change Orders and Requests for Information.

2. The Contractor’s Quality Control Representative shall be in on-site during any schedule special inspections and testing required by the documents under their contract.

F. The Contractor’s Quality Control Representative shall be at all pre-installation meetings, coordination meetings, and any other meetings scheduled to ensure the quality of the project.

G. The Contractor’s Quality Control Representative shall perform all Contractor Inspections, including material, pre-installation, initial, follow-up, and final inspections.

1. Pre-Construction Inspections responsibilities - Contractor’s Quality Control Representative shall notify Construction Manager in writing within 24 hours of any issues, deficiencies, etc. with the existing conditions, substrate, etc. that would hinder the contractor’s ability to install their work.
   a. Starting of Contractor’s work is acknowledgment of Contractor’s acceptance of the substrate and as a result any rework required by the Contractor to sell their work is the responsibility of the Contractor.

2. During Inspections of Contractor’s work, the Contractor’s Quality Control Representative shall notify Construction Manager in writing within 24 hours of any issues, deficiencies, etc. found. As well as what remedies the Contractor will take to resolve such matters.

H. See Testing and Inspections for additional responsibilities

II. CORE DRILLS

A. Core drilling is permitted only with the prior written approval of the Construction Manager and Architect. Damages caused by the failure to observe the above precautions are the responsibility of the Contractor/Subcontractor.

III. MOCK-UP

A. Contractors are responsible for coordinating with the Construction Manager all mock-ups required for this Project. The Architect’s approval must be given in writing before the Contractor can continue the work.

IV. OWNER-PURCHASED SUPPLIES, MATERIALS AND EQUIPMENT

A. Where materials are provided by Owner but installed by Contractor, each Contractor’s representative will be responsible for verification of owner provided materials, supplies, and equipment to confirm the following.

1. Quantities of materials, equipment, and supplies received. Sign off on and provide to Construction Manager the Bill of Landing signed by Contractor and Shipper.
   a. List of any damaged goods should be part of the signed off Bill of Landing.
   b. Both Contractor and Shipper should initial next to items damaged and pictures should be taken that are date and time stamped verifying damage.

2. Notify Construction Manager within 24 hours of any issues with quantities received and those required to be installed by the documents.

3. Contractor takes on responsibility for storage, security, etc. upon receipt of Owner provided supplies, materials or equipment.

4. The Construction Manager will require the following from Contractors for all Owner-purchased supplies, materials and/or equipment stored off site.
   a. Proof of delivery to site stored.
   b. Segregated storage areas and identified materials.
   c. Insured facilities (i.e., bonded warehouse).
   d. Signed Bailment Receipt.
   e. Signed Bill of Sale (as applicable).
5. The Contractor will be responsible to coordinate all Owner-furnished items assigned to his contract.

V. TESTING AND INSPECTIONS
A. SCOPE OF WORK
1. Employment of a testing and inspection firm approved and paid for by the Owner. Approximate scope of testing and inspection shall be as indicated on the drawings and herein specified in the sections of the specifications.

B. TESTING AND INSPECTION CHARGES
1. For the following conditions, costs of testing and inspection services shall be paid for by the Contractor, apart from the Testing and Inspection.
   a. Costs arising from errors or omissions by the Contractor.
   b. Costs of concrete cores, of re-testing materials that fail, and of required identification of materials (mill tests, manufacturers’ certifications, etc.).
   c. Costs of tests and inspections required to expedite the Contractor’s operations.

C. EARTHWORK
1. The Soils Engineer shall be notified for inspection by the Contractor and shall work in cooperation with the Architect and Construction Manager. This inspection shall be made before any excavation is attempted on the site. If any undesirable conditions are encountered during Construction, the Soils Engineer shall be notified so that supplemental recommendations can be made. Tests shall be made to define maximum densities of all compaction work. All densities shall be expressed as a relative compaction, in terms of the maximum dry density obtained in the laboratory. The Soils Engineer shall supervise all engineered fill, and make field tests to insure compliance with the required placement of footings; methods of placing and compacting fills; filter and/or rock fill materials.

D. CONCRETE WORK
1. Reinforcement shall be positively identified by heat numbers and mill analysis. Otherwise, Contractor shall provide tests by qualified laboratory, one test for each 5 tons or fraction thereof, each size and type of reinforcing steel. Cement shall be from tested bins and properly identified at the mixing plant. Contractor shall provide to the testing laboratory, aggregate samples for approval. Testing laboratory shall prepare 3 concrete cylinders for each 25 cubic yards, or fraction thereof placed - 2 cylinders to be tested at 7 days, and 1 cylinder at 28 days. Follow ASTM standards throughout.

E. GENERAL TESTS AND INSPECTIONS
1. Observe all building code test and special inspection requirements. Notify proper State, County and City authorities, for their required inspections.
2. Refer to Structural General Notes for additional testing and inspection requirements.
3. A four-point inspection plan for each of the Bid Package work areas to be performed under contract will be utilized.
4. Pre-Construction coordination - Prior to commencing work, the Contractor’s quality control representative will meet with the Construction Manager’s representative. Items to be reviewed are as follows:
   a. Approval of shop drawings and submittals.
   b. Approval of inspection and test reports on materials and equipment to be utilized.
   c. Completion and acceptance of previous operations.
   d. Availability of materials and equipment required.
   e. Any other preparatory steps dependent upon the particular operations.
   f. Safety or environmental precautions to be observed.
5. Material inspection’s
   a. Contractor’s Quality Control Representative shall upon receipt at the site, perform an inspection of all materials, equipment and supplies including those furnished him by the Owner.
      i. Items which are damaged or not in conformance with the respective submittals, quality standards, contract documents, contract drawings and specifications will be identified and segregated from accepted items. Items thus identified will not be incorporated into the work until corrective action, acceptable to the Construction.
6. Initial inspection - Upon completion of a representative sample of a given work, the Contractor’s quality control representative will schedule an inspection with the Construction Manager and Architect’s representatives to review, at a minimum, the following items:
   a. Workmanship to establish quality standards.
   b. Configuration to Contract Documents including contract drawings and specifications.
   c. Construction methods, equipment and tools utilized.
   d. Materials and articles utilized.
   e. Testing methods required.
   f. Approved shop drawings required.
   g. Safety or environmental precautions required.

7. Follow-up inspections - The Contractor’s quality control representative will inspect the work daily to ensure the continuing conformance of the work to the workmanship standards established during the preconstruction and initial inspections. Follow-up inspections will be on a daily basis and recorded in the Contractor’s daily log.

8. Completion inspection - Upon completion of a given area of work, the Contractor’s quality control representative will schedule an inspection with the Construction Manager’s representative. Nonconforming items will be identified and corrected.

9. Reference 014529 for Additional Testing and Laboratory Procedures

VI. SAFETY

A. Contractors who perform any work under this Contract will fully comply with the provisions of the Federal Occupational Safety and Health Act of 1970 and/or the Construction Safety Act 8 of 1969 (whichever is applicable) to the rules and regulations promulgated pursuant to this Act.

B. Owner's Hazardous Materials –
   1. Upon request, Contractors will be provided list of hazardous materials in the areas where the contractors are working within the building.
   2. Material Safety Data Sheets (MSDS) will be made available to the Contractor's Representative upon request.

C. Hazardous Material. In the event the Contractor encounters on the site, material reasonably believed to be asbestos or polychlorinated biphenyl (PCB) which has not been rendered harmless, the Contractor shall immediately stop work and notify the Construction Manager, Architect and Owner. Such notification shall be documented in writing.

D. Contractors shall keep MSDS sheets on file at the General Contractor's jobsite office, and make available to the School's Administration for all hazardous materials brought onto the project site.

E. Provide any and all measures of protection required by the local authorities, for the protection of the public and employees during excavation operations and at completion of work. Measures taken shall include but not be limited to: sidewalks, barricades, warning lights, and signs; and shall comply with American Standard Safety Code and all local laws and ordinances. Maintain in good condition during operations.

F. Contractors will be required to submit to the Construction Manager their Project Specific Safety Plan for review by the Construction Manager, Design Team and Owner.
   1. At a Minimum the Contractors Plan should contain the following.
      a. Cover Sheet
      b. Name of Project, Contractor, Construction Manager, Architect, and Owner
      c. Contractor’s Key Personal with names, email, and phone numbers, as well as responsibility on the project.
      d. General Project Working Rules.
      e. PPE Required.
      f. List of Equipment/Materials/Tools to be used on the project.
      g. Certifications and Training Records of Personal.
      h. Job Hazard Analysis / Pre-Task Plan Templates
i. Permits required. (ie. Confined Space, Excavation, Fall Protection Plan, Hot Work, etc.)

j. List of Personal having OSHA 10 Hour Training and copies of certificates.

k. MSDS Information.

l. Injury Management Plan.

m. Any additional information requested by Construction Manager, Design Team, or Owner.

2. Contractor’s Safety Plan should be submitted within 30 Calendar’s from Notice to Proceed.
   a. In the even that Contractor’s work is taking place that the 30 Calendar Days puts the submission of this plan after the start of work, then such plan should be submitted within 7 Calendar days from start of Contractor’s work.

G. Drug Testing and Background Checks
1. Contractors will be required to perform Background Checks and Drug and Alcohol testing on all personal who will be working at the job site.
   a. A list of names of the personal who have passed the Background Check and Drug/Alcohol testing shall be submitted to the Construction Manager 5 days prior to the start of Construction.
   b. Background Checks shall meet the requirements Missouri State Statute Section 168.133.1.

2. Contractors will be required to adhere to Missouri State Statute Section 161.371.1 and perform Random Drug and Alcohol Testing during the course of Construction. Contractor shall keep results of such testing and submit to the Construction Manager/Owner upon their request an updated list of authorized personal who are working on the project, the date of their last test.
   a. Contractor shall notify the Construction Manager/School District in the event any worker should test positive and what action the Contractor has taken to protect the safety of students as a result of a positive test.

3. Cost of Background Checks and Drug Testing is the responsibility of each Contractor.

END OF DOCUMENT

014000
1.01. SCOPE
A. Owner will appoint, employ and pay for specified services for an independent firm to perform inspecting and testing specified elsewhere.
B. The testing laboratory for soils and foundation work shall be the same lab who performed the subsurface inspections, no exception.
C. The independent testing agency will perform inspections, tests and other services specified in individual specification sections and as required by the Architect or the Owner, and tests required by Special Inspection provisions of the governing authority's adopted building code.
D. Inspecting, testing and source quality control may occur on or off the project site. Perform off-site inspecting or testing as required by the Architect or the Owner.
E. Reports shall be submitted by the independent testing agency to the Construction Manager, Architect and Contractor, indicating observations and results of tests or non-compliance with Contract Documents.
F. Each Contractor shall cooperate with independent testing laboratory, furnish samples of materials, design mix, equipment, tools, storage, safe access and assistance by incidental labor as requested.
1. Notify Architect and independent testing laboratory 24 hours prior to expected time for operations requiring services. Payment for scheduled testing which are canceled or not required at the schedule time, due to construction delays will be charged to the Contractor by deducting inspecting or testing charges from the Contract Sum/Price.
2. Make arrangements with independent testing laboratory and pay for additional samples and tests required for Contractor's use.
G. Testing or inspecting does not relieve Contractor to perform Work to contract requirements.
H. Retesting – Costs for retesting shall be the responsibility of the Contractor in non-conformance.

1.02. REFERENCES
A. ASTM C802 - Practice for Conducting an Inter-laboratory Test Program to Determine the Precision of Test Methods for Construction.
C. ASTM C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
D. ASTM C1093 - Practice for Accreditation of Testing Agencies for Unit Masonry.
E. ASTM D290 - Recommended Practice for Bituminous Mixing Plant Inspection.
F. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
H. ASTM E329 - Practice for Use in the Evaluation of Inspection and Testing Agencies as used in Construction.
I. ASTM E543 - Practice for Determining the Qualification of Nondestructive Testing Agencies.

1.03. SELECTION AND PAYMENT
A. Owner will employ and pay for services of an independent testing laboratory to perform specified inspecting and testing.

1.04. QUALITY ASSURANCE
A. Comply with requirements of the appropriate ASTM sections.
B. Laboratory: Authorized to operate in State in which Project is located.
C. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
D. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.05. LABORATORY RESPONSIBILITIES
A. Test samples of mixes submitted by Contractor.
B. Provide qualified personnel at site. Cooperate with Construction Manager, Architect and Contractor in performance of services.
C. Perform specified inspecting, sampling, and testing of products in accordance with specified standards.
D. Ascertain compliance of materials and mixes with requirements of Contract Documents.
E. Promptly notify Construction Manager, Architect and Contractor of observed irregularities or non-conformance of Work or Products.
F. Perform additional inspection and tests required by Architect and Owner.

1.06. LABORATORY REPORTS
A. After each inspection and test, promptly submit copies of laboratory reports to Construction Manager, Architect and Contractor.
B. Included:
   1. Date issued,
   2. Project title and number,
   3. Name of inspector,
   4. Date and time of sampling or inspection,
   5. Identification of product and specifications section,
   6. Location in the Project,
   7. Type of inspection or test,
   8. Date of test,
   9. Results of tests,
C. When requested by Architect, provide interpretation of test results.

1.07. LIMITS ON TESTING LABORATORY AUTHORITY
A. Laboratory may not release, revoke, alter or enlarge on requirements of Contract Documents.
B. Laboratory may not approve or accept any portion of the Work.
C. Laboratory may not assume any duties of the Contractor.
D. Laboratory has no authority to stop the Work.

1.08. CONTRACTOR RESPONSIBILITIES
A. Deliver to laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
B. Cooperate with laboratory personnel, and provide access to the Work.
C. Provide incidental labor and facilities:
   1. to provide access to Work to be tested,
   2. to obtain and handle samples at the site or at source of products to be tested,
   3. to facilitate tests and inspections,
   4. to provide storage and curing of test samples.
D. Notify Architect and Laboratory 24 hours prior to expected time for operations requiring inspecting and testing services. Inspection and testing services shall be performed during normal business hours, unless approval by the Architect is obtained 24 hours prior to the inspection and testing. The costs incurred by after hours inspection and testing are the responsibility of the Contractor.

E. Arrange with laboratory and pay for additional samples and tests required by Contractor beyond specified requirements.
1. GENERAL
   A. Summary: This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection. In addition, this Section delineates those facilities and controls to be provided by the Construction Manager and the Owner. Refer to individual Bid Package - Scopes of Work for temporary utilities to be provided by each Contractor.
   B. Each Contractor shall be responsible for coordinating and scheduling among all trades and his Subcontractors the furnishing and use of all temporary facilities required for the Work through the Construction Manager.
   C. Unless specifically noted as the Owner’s or Construction Manager’s responsibility, each Contractor and Subcontractor shall provide the temporary materials and equipment necessary to accomplish their own work.

2. REQUIREMENTS OF REGULATORY AGENCIES
   A. Regulations: Contractor’s shall comply with industry standards, applicable laws and regulations of authorities having jurisdiction over work involved in the Project, including but not limited to the following:
      I. Building Code requirements.
      II. Health and safety regulations.
      III. Utility company regulations.
      IV. Police, Fire Department and Rescue Squad rules.
      V. Environmental protection regulations.
   B. Contractors shall obtain and pay all associated costs for any necessary permits, fees and inspections for all temporary work to be performed.
   C. Do not interfere with normal use of streets in the vicinity of the project sites except as indicated on drawings and/or as absolutely necessary to execute required work, and then only after proper arrangements have been made with applicable City authorities, including traffic control, street clean-up and repairs.

3. CONSTRUCTION ACCESS AND PARKING
   A. Each Contractor shall be responsible for all traffic control at streets adjacent to project sites as required when vehicles enter and leave the site. Contractor shall maintain personnel traffic and control, the personnel will enter such construction area as indicated by the Construction Manager. The construction entrance(s) will be maintained for the duration of the Project, but the location may change as the construction progresses. Comply with all governing City regulations for traffic control.
   B. Temporary parking facilities for construction personnel and equipment shall be confined to areas within the Construction Limit Lines. The Owner assumes no responsibility for temporary parking.
      I. Parking on new parking lots is allowed in areas designated by the Construction Manager.
      II. Repair any damage to existing pavement, grounds or other construction to remain when damage results from operations under this Contract.
   C. Access to the Site by all personnel and deliveries shall be on driveways as shown on the Drawings and/or Site Staging Plan. Travel on any route other than described on such shall not be permitted.

4. STORAGE AND STAGING AREAS
   A. All supplies, materials and equipment purchased by the Owner or furnished by the Owner for installation by the Contractor shall, upon delivery to the jobsite, be unloaded, transferred, stored and fully protected from the weather by the Contractor (responsible for the installation) until installed. Any demurrage or similar charge incurred due to failure of the Contractor to promptly unload the materials and equipment shall be the responsibility of the Contractor.
   B. If it becomes necessary at any time during construction to move materials which are to enter into construction, or equipment and barricades which have been temporarily placed, the Contractor
furnishing these materials, equipment or barricades shall, when directed by the Construction Manager move them or cause them to be moved without additional charge to the Owner and/or Construction Manager.

C. Each Contractor shall carefully examine all materials and equipment purchased by the Owner. The Contractor shall be responsible for subsequent damage or loss until installation is completed and accepted by the Owner, Construction Manager and Architect. Should the Contractor fail to report any visible signs of damage, then it will be understood the damage occurred while the materials and equipment were in care, custody and control of the Contractor.

D. Temporary structures of combustible materials shall be located, per OSHA and/or other Authorities having Jurisdiction, from permanent structures.
   I. Combustible materials must be properly identified as required by OSHA/Governing Authorities.

E. Staging areas for Contractors use will be designated by the Construction Manager
   I. Contractor will be responsible for relocating Trailers, Equipment, Materials, Tools, etc. as directed by the Construction Manager. This includes movement of such offsite as staging areas are needed for completion.
   II. Contractor will be responsible for storing all materials off site until such time they are need on site.
   III. The building/structure will not be used for staging, storage, etc. unless prior approval by the Construction Manager.
       a. Upon notice from the Construction Manager, Contractors will be required to immediately move materials allowed to be stored within the building.

5. WATER FOR CONSTRUCTION
A. The Contractor, as he deems necessary, shall make all necessary arrangements with the utility company to provide a temporary meter and temporary water service to the site to meet construction requirements throughout the Project or until permanent services are completed. Contractor shall also provide bulk water. Contractor shall provide, maintain and pay for his own valves, and distribution piping. Provide suitable fixtures at terminations of lines.
   I. Owner shall pay cost of water used.
B. Each Contractor shall be responsible for furnishing his own connections (extension devices, etc.) To extend services for construction activities at his own expense, and for making special provisions for unusual water requirements for the execution of his work.
C. Do not extend temporary utilities across open site areas in such a way that it would cause a possible safety hazard.

6. ELECTRICAL ENERGY, LIGHTING AND WIRING
A. The Electrical Contractor will make all necessary arrangements with the utility company to provide a temporary meter and temporary service to the site to meet the construction requirements throughout the Project or until permanent services are completed. All electrical connections must meet local code requirements. Temporary service and extensions thereof shall be provided by the Electrical Contractor as work progresses so that all work is within 100 feet of electrical service.
   I. All electricity used during Construction will be paid for by Owner.
   II. Electrical Contractor shall also provide temporary lighting until permanent lighting is completed.
B. Electrical service will be available in reasonable quantities for use by each Contractor. Restrict the use of such utility services to only those activities that are directly related to the construction work.
   I. Contractors shall provide, maintain and pay for any additional electrical service required by their forces, which is beyond the capacity of the temporary system provided. Provide all temporary lighting and wiring required for extension of energy of ample quality and quantity for accurate and efficient performance of the work within the confines of the project.
C. Contractors shall be responsible for furnishing their own connections (extension devices, etc.)
to extend services from construction activities at their own expense, and for making special provisions for unusual power requirements of any of the Subcontractors.

D. Do not extend temporary utilities across open site areas in such a way that it would cause a possible safety hazard.

7. HEATING AND VENTILATION
   A. Each Contractor working on the exterior of the building shall provide and pay for necessary temporary coverings, enclosures, ventilation and/or heating to protect workmen and the work against injury or damage by weather elements.
   B. Use safe, effective means of heating, ventilation and/or other required protection at all times. Maintain temperatures and ventilation required for proper installation and completion of work by all trades.
      I. The use of salamanders and other propane and kerosene heaters may be permitted as approved by the Construction Manager.
      II. See requirements in individual specification sections for temperatures to be maintained for work under various trades, and for those special cases where a particular type of heat or heating apparatus may be required.
   C. If the heating and ventilating system has not been completed when heat is required, provide such temporary heat and/or other protection as may be necessary to protect all work and materials against injury from dampness and cold.
   D. The HVAC Contractor shall start up permanent equipment as finish work commences, change filters, clean HVAC equipment used and protect warranty for HVAC equipment. The new heating and ventilating system may be used after it has been installed, checked and proven to be in satisfactory operating condition and proper insurance is in effect. Use of this equipment during construction however shall not alter the Warranty beginning point as defined in the Supplementary General Conditions.
      I. When the new heating and ventilating system is used for temporary service during construction, it is understood that this use in no way affects the guarantees which become effective at the time of Substantial Completion.
      II. New equipment if used, shall be thoroughly cleaned and all filters shall be replaced.

8. JOB TELEPHONE AND COMMUNICATION EQUIPMENT
   A. Construction Manager will furnish and maintain at the job site office a Computer with Internet Access and printing capabilities for use by the Owner, Architect, and Construction Manager
   B. Contractor is required to have their own computer, printer, and internet access as necessary for the completion of their work.
   C. Contractor’s onsite foreman is required to have cell phone and such number is to be made available to the Construction Manager

9. FIELD OFFICE AND TEMPORARY STORAGE
   A. The Construction Manager will provide and maintain a field office at Project site for his and the Architect’s use. Each Contractor, as he deems necessary, shall provide and maintain a field office and other temporary structures for their own use. Each Contractor must review use of the field office with the Construction Manager. Each Contractor shall provide suitable storage facilities for materials delivered to the site to protect materials from weather, contamination and damage. The Construction Manager will maintain and have available at all times, copies of the Plans, Specifications, Shop Drawings and other data pertinent to the Work for reference.

10. SUPERINTENDENT/LEAD FOREMAN
    A. A full time onsite Lead Personal will be required by each Contractor and such shall be on-site at all times when Contractor’s work is being performed and shall be available via a cell phone during normal job site hours, Monday through Friday. The same Lead Field Personal shall stay with the Project from start-up through completion of the punch list work before leaving the Project.
    B. Construction Manager / Owner reserve the right to approve the onsite Lead Personal the
Contractor is planning on using on the project and make request that Contractor provide another candidate if the Construction Manager/Owner has reasonable objections to such personal. The Contractor's onsite Lead Personal shall have experience working on at least 3 previous projects of this size and scope.

C. In the event the Contractor has to change onsite Lead Personal they shall notify the Construction Manager 14 days prior to removal of Lead Personal and provide a list of candidates to which they would like to replace the Lead Personal with for Construction Manager / Owner to approve.

11. HEALTH AND SANITATION
A. Drinking Water: Contractors are to provide an adequate supply of portable drinking water, satisfactorily cooled, free of contamination, and conforming to State and local requirements for their own forces engaged in work on the Project.
B. Construction Manager shall provide portable chemical toilets, of type acceptable to public health authorities, in quantity to meet the needs of all workmen and agents present on the project site. Locate in convenient locations acceptable to the Owner, and relocate as necessary as work progresses.
C. No workmen will be permitted to use the Owner's toilets.
D. Each Contractor will keep all stored materials in a neat and organized in an area designated by the Construction Manager. Each Contractor shall protect all stored materials from the elements.
E. Lunches only to be eaten in areas designated by the Construction Manager. No food or drink in the building.

12. COLLECTION AND DISPOSAL OF WASTE
A. Contractors shall clean up and remove to designated points at the site, daily and as directed by the Construction Manager, all rubbish and debris resulting from the Contractor's work and shall clean up his work to the satisfaction of the Construction Manager. In the event the Contractor fails to clean up in accordance with the directions, the Construction Manager, after twenty-four (24) hours written notice to the Contractor, reserves the right to arrange otherwise for the clean up to be done and charge the Contractor the cost.
B. All Contractors shall ensure that all boxes, cartons, etc., are crushed to the minimum volume prior to placing in the trash containers or trash collection areas. No paint cloths will be allowed in trash container. Construction Manager will provide dumpsters for use by the Contractor.
C. The disposal of any material, waste, effluents, trash, garbage, or oil, grease, chemical, etc., resulting from either demolition or new work, shall be disposed of in accordance with all applicable laws and shall be subject to the approval of the Construction Manager. Any materials disposed of in an unauthorized place or manner shall be removed and the area restored to its original undisturbed condition at the expense of the Contractor.

13. TEMPORARY FIRE PROTECTION
A. Until fire protection needs are supplied by permanent facilities, Contractor shall install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers", and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".
   I. Locate fire extinguishers where convenient and effective for their intended purpose.
   II. Store combustible materials in containers in fire-safe locations.
   III. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
   IV. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

14. BARRICADES, WORKING SIGNS AND LIGHTS
A. Each Contractor shall provide temporary safeguards as required by OSHA, and/or Governing
Authorities to perform their work, to provide safety of workmen and the public and to provide protection of the work installed.

B. Maintain continuous protection of the public along adjacent property and adjacent streets as required in accordance with requirements of OSHA and/or governing authorities.

C. Comply with standards and code requirements for erection of structurally adequate barricades around open excavations. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.

D. Contractors shall be responsible for security and weather protection of building interiors. Provide temporary barriers as necessary where permanent construction is not in place.

15. ENVIRONMENTAL PROTECTIONS
   A. Each Contractor shall provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from adjacent property owners.

16. GRADES, LINES, AND LEVELS
   A. The Owner’s surveyor will provide horizontal and vertical control points for the site Work as directed by the Construction Manager prior to the start of construction.
      I. Any surveying services required beyond this definition will be the responsibility of each Contractor. Each Contractor shall lay out lines, levels and locations for his work in accordance with the information furnished on the drawings. Each Contractor shall be held responsible for all errors resulting from failure to verify all figures from reference points given in the furnished information and drawings, before laying out the work. Drawings shall not be scaled.

   B. Contractors shall preserve all stakes and other marks established by the Construction Manager and others. If such marks are destroyed by the Contractor, the Contractor shall obtain the services of a licensed land surveyor, satisfactory to the Construction Manager, who shall re-establish these points without delay to the work and at no cost to the Construction Manager or others.

   C. Permanent batter boards, reference stakes and benchmarks shall be installed, protected from displacement and checked periodically for accuracy. Upon completion of the Work, all reference marks shall again be checked, replaced if necessary and left in place.

17. SCAFFOLDING, LADDERS AND HOISTS
   A. Each Contractor shall provide and maintain all temporary scaffolding, ladders and hoists required during construction, complete with all required permits and licenses.

   B. If temporary hoisting equipment is to be anchored to or supported by building structure and/or related building construction, submit layout of equipment loads involved, anchorage proposed and other pertinent data for review by the Architect, Construction Manager and Structural Engineer Consultant prior to installation.

18. EQUIPMENT ACCESS
   A. Make all necessary provisions to ensure that required materials and equipment can be physically delivered to their final destination in the project. Such temporary provisions may include openings in floors or walls, enlargement of openings, or requiring items to be shipped in "knocked-down" form and assembled at the final destination.
      I. All such provisions must be approved by the Construction Manager and Architect before the work is started.

19. TEMPORARY PROTECTION
   A. When any Contractor's operations require him to do work over or adjacent to existing work, he shall protect such work in the best possible manner.
I. Provide protection for walls, windows, or other finished work.
II. Protect installed floor against damage during construction period with heavy kraft paper or other covering acceptable to the flooring manufacturer.
   a. Protect resilient flooring and carpeting against rolling loads and potential gouging for initial period following installation. Do not move stationary equipment or furnishings across floors by sliding or dragging.

20. ENCLOSURES
   A. Each Contractor shall provide temporary closures as set forth in their respective Scope of Work.
   B. Any roof area uncovered must be made water-tight at end of each day.

21. OPERATION, TERMINATION AND REMOVAL
   A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
   B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
   C. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Repair any damaged work.
   I. Materials and facilities that constitute temporary facilities are property of the Contractor except as otherwise indicated.

22. WATCHMAN
   A. Each Contractor shall be solely responsible for the safety of his own materials, equipment, tools, etc. on the site, and shall, if he deems it necessary or expedient, employ at his own expense the services of a competent watchman. The Owner disclaims all responsibility for the safety of the Contractor's materials, equipment, tools, etc., or any damage which may be done to same due to vandalism, theft or any other cause.

23. TOBACCO AND ALCOHOL USAGE
   A. Usage of and possession of tobacco products, alcohol, drugs and weapons on district property is a violation of School District policy.

24. SAFETY
   A. Safety on the Project site is a primary concern to the Owner and Construction Manager. Each Contractor is responsible for the safety and security of their employees. OSHA and general safety regulations must be observed and maintained as a minimum standard in all cases. Failure to comply with safety requirements, will be considered as non-compliance with the Contract, and will result in remedial action, including but not limited to, withholding of progress payments. Owner reserves the right to have unsafe conditions corrected by others, if Contractor fails to do so when requested and back-charged Contractor for costs.

25. FIRST AID
   A. The Construction Manager will maintain a first aid center in the Project trailer. The Construction Manager will have phone numbers of the local clinics and hospitals posted at all times.

   A. SUMMARY
      I. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
      II. Related Sections:
         a. Division 01 Section "Temporary Facilities and Controls" for temporary site fencing.
         b. Division 31 Section "Site Clearing" for removing existing trees and shrubs.
   B. DEFINITIONS
      I. Caliper: Diameter of a trunk measured by the average of the smallest and largest diameters at 6 inches () above the ground for trees up to, and including, 4-inch () size; and 12 inches ()
above the ground for trees larger than 4-inch () size.
II. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
III. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

C. PROJECT CONDITIONS
I. The following practices are prohibited within protection zones:
   a. Storage of construction materials, debris, or excavated material.
   b. Parking vehicles or equipment.
   c. Erection of sheds or structures.
   d. Impoundment of water.
   e. Excavation or other digging, unless otherwise indicated.
   f. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
II. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

D. MATERIALS
I. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements.
   a. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch () maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (); remaining flexible from minus 60 to plus 200 deg F (); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi () and ultimate tensile strength of 2680 psi (); secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet () apart.
      i. Height: 4 feet ().
      ii. Color: High-visibility orange, nonfading.

E. EXAMINATION AND PREPARATION
I. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
   a. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.
II. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Tie a 1-inch () blue-vinyl tape around each tree trunk at 54 inches () above the ground.
III. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

F. TREE- AND PLANT-PROTECTION ZONES
I. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
   a. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
   b. Maintain protection zones free of weeds and trash.
II. Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
III. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   a. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
G. REPAIR AND REPLACEMENT
   I. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be
      relocated that are damaged by construction operations, in a manner approved by Architect.
   II. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or
      in an unhealthy condition before the end of the corrections period or are damaged during
      construction operations that Architect determines are incapable of restoring to normal growth
      pattern.
         a. Provide new trees of same size and species as those being replaced for each tree that
            measures 4 inches (ø) or smaller in caliper size.
         b. Provide one new tree(s) of 4-inch (ø) caliper size for each tree being replaced that
            measures more than 6 inches (ø) in caliper size.
         c. Species: Species selected by Architect.
   c. Plant and maintain new trees as specified in Division 32 Section “Plants.”

H. DISPOSAL OF SURPLUS AND WASTE MATERIALS
   I. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally
      dispose of them off Owner's property.
1.01 DIMENSIONS AND LAYOUT OF WORK
A. Place all work by dimensions and locations shown on the Drawings.
B. Locations of equipment and devices and other work indicated on the drawings need to be verified as to exact locations on the job, subject to structural conditions, work of other contractors, access requirements for installation and maintenance to the approval of the Construction Manager, Architect and Engineers.
C. Study and become familiar with the contract drawings of other trades and in particular the Architectural, Structural, Mechanical, Electrical, and Civil plans and details in order to obtain necessary information for figuring installation. Coordinate and Cooperate with other trades and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitations may be permitted if reviewed prior to installation by the Construction Manager or the Architect/Engineer.
D. Any apparatus, appliance or other item interfering with the proper placement of other work as indicated on drawings, specified or required, shall be removed and if necessary, relocated and reconnected without extra cost. Damage to other work caused by this contractor or his subcontractor or workers shall be restored as specified for new work.
E. Verify in the field all dimensions and coordinate work with other trades before fabricating or placing any products.

1.02 RECEIVING AND STORING MATERIAL
A. On receipt of materials, check for in-transit damage in ample time to replace any damaged materials prior to installation time. Whenever possible, deliver materials and equipment to project site in manufacturer’s original packages, keeping labels intact until final cleaning.
B. Store materials in a manner to prevent deterioration, staining, soiling and intrusion of foreign materials. Provide waterproof, well ventilated enclosures for materials subject to deterioration by dampness and protect those materials subject to damage by freezing and frost. Remove from premises and replace with new, any material showing deterioration or damage, at no expense to the owner.

1.03 INSTALLATION OF MATERIALS
A. Contractor, Subcontractor and their employees shall be thoroughly familiar with all materials, finishes, equipment, etc., incorporated in the Work and shall be responsible for the proper installation and/or application of such. Complete current copies of manufacturer’s installation instructions shall be on file at project site for all items to be incorporated in work.
B. Furnish, apply, install, connect, erect, clean and conditioned manufactured articles, materials and equipment per manufacturer’s printed directions unless otherwise indicated or specified. The Drawings and Specifications shall in no way alter or be construed as altering the manufacturer’s warranty or installation recommendations.
C. Provide all attachment devices and materials necessary to secure materials together or to other materials and to secure work of other trades. Make allowances for ample expansion and contraction for all building components subject to same.
D. Where fabrics, plastics and other such items join, Contractor shall make seams tight, secure and inconspicuous. Scribe and/or otherwise neatly fit materials to adjoining materials.

E. Each trade shall provide sleeves, recesses and openings required to receive work of other trades.

F. Make field check of actual building dimensions before fabricating products. Where proper fit of work depends upon close tolerances of manufactured products, furnish manufacturer with necessary templates to insure proper fit of components.

G. Properly prepare all work to receive subsequent work or finish.

H. Notify Architect for mounting height or position of any unit, fixture or miscellaneous object not specifically located.

I. Mix no more materials than can be used before materials begin to “set.” Mix no partially “set” batch with another. Clean tools and appliances prior to mixing materials that can be contaminated. Do not disturb materials requiring curing time until appropriate curing time has transpired. Install materials only when conditions of temperature, moisture, humidity and condition of adjacent building components are conducive to achieving best installation results.

J. In job-assembling, each trade properly cut and fit to make its assemblies fit accurately and cut and fit as necessary for other trades having work to occur therein.

K. Where necessary to cut into other building components, do so only in a manner not to damage building structurally or aesthetically, then repair adjoining part thoroughly and neatly.

L. Leave finished surfaces smooth and flat or of smooth contour where indicated, free from wrinkles, warps, scratches, dents and other imperfections.

M. Erect, install and secure building components in a structurally sound and appropriate manner. Where necessary, temporarily brace, shore or otherwise support members until final connection or installation.

N. Where obviously of best practice, furnish materials in longest practical lengths and largest practical sizes to avoid unnecessary joints. Make all joints secure.

1.04 PROTECTION OF WORK

A. Provide cover and protection for work from inclement weather and brace all construction to prevent damage from wind. Keep covered all materials, cavities and holes subject to damage from falling materials, deposits of water, snow or ice.

B. Support no runways, ramps nor construction equipment on, nor transport over, any items or assemblies subject to displacement, disfigurement or other damage.

C. Protect work in place requiring job finishing until such finishing has been completed. Protect previously placed work by suitable coverings during installation of subsequent work.

D. Clean off any foreign materials accidentally deposited on finished surfaces and where such would stain, corrode or otherwise disfigure. Clean same immediately with materials that will not damage finished work.

E. Where finished floors are subject to damage, suitably cover traffic areas until building acceptance.

F. Once glass, mirrors and other such damageable items have been installed, identify same with appropriate warning markings and leave on until final cleaning.

1.05 WORKMANSHIP

A. Workmanship of all trades and crafts shall be not less than the highest accepted standard of that trade or craft. Contractor shall adjust personnel to accomplish highest quality workmanship. Work indicating inferior workmanship will be rejected and subcontractor will be responsible for replacement at his cost.
1.06 CLOSING-IN-WORK
   A. Neither enclose nor cover piping, wiring, ducts, equipment or other items until proper test and inspection have been made by Architect and/or proper authorities.
   B. Notify Architect to inspect any work when placing of subsequent work would prevent observation of previous work.

1.07 COMPLETED WORK
   A. Completed work shall find materials structurally sound, free from scratches, abrasions, distortions, chips, breaks, blisters, holes, splits or other disfigurements considered as imperfections for the specific material.

END OF DOCUMENT
017300
1. **SCOPE:** Requirements and limitations for cutting and patching of Work.

2. **RELATED SECTIONS**
   A. Section 01010 - Summary of Work
   B. Section 01341 – Submittals
   C. Section 01601 - Materials and Equipment
   D. Section 01630 - Substitutions and Product Options
   E. Individual Product Specification Sections:
      I. Cutting and patching incidental to work of the section.
      II. Advance notification to other sections of openings required in work of those sections.
      III. Limitations on cutting structural members.

3. **SUBMITTALS**
   A. Submit written request in advance of cutting or alteration which affects:
      I. Structural integrity of any element of Project.
      II. Integrity of weather exposed or moisture resistant element.
      III. Efficiency, maintenance, or safety of any operational element.
      IV. Visual qualities of sight exposed elements.
      V. Work of Owner or separate contractor.
   B. Include in request:
      I. Identification of Project.
      II. Location and description of affected Work.
      III. Necessity for cutting or alteration.
      IV. Description of proposed Work and Products to be used.
      V. Alternatives to cutting and patching.
      VI. Effect on work of Owner or separate contractor.
      VII. Written permission of affected separate contractor.
      VIII. Date and time work will be executed.

4. **EXAMINATION**
   A. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
   B. After uncovering existing Work, access conditions affecting performance of work.
   C. Beginning of cutting or patching means acceptance of existing conditions.

5. **PREPARATION**
   A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
   B. Provide protection from elements for areas which may be exposed by uncovering work.
   C. Maintain excavations free of water.

6. **CUTTING**
   A. Execute cutting and fitting to complete the Work.
   B. Uncover work to install improperly sequenced work.
   C. Remove and replace defective or non-conforming work.
   D. Remove samples of installed work for testing when required.
   E. Provide openings in the Work for penetration of mechanical and electrical work.
   F. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight-exposed surfaces.
   G. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
   H. Trades must provide necessary measures to ensure proper indoor air quality per OSHA and/or other governing agencies for work indoors.
7. **PATCHING**
   A. Materials for patching shall follow original specifications or shall match existing to the extent possible with currently available materials.
   B. Execute patching to complement adjacent Work.
   C. Fit Products together to integrate with other Work.
   D. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
   E. Employ original installer to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.
   F. Restore work with new Products in accordance with requirements of Contract Documents.
   G. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
   H. At penetration of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with the specifications and code requirements, to full thickness of the penetrated element.
   I. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   J. Patch flooring with approved quick cure products and/or barriers as required where indicated to ensure proper completion of finished flooring.

END OF DOCUMENT
017329
1.01 DESCRIPTION
A. Each Contractor will be responsible to execute daily cleaning, during progress of the Work and at completion of the Work, as required by General Conditions. The Contractor is to daily, broom clean debris and remove all refuse, rubbish, scrap material caused by his operation. The Contractor shall remove all excess spoils to an area on the site as directed by the Construction Manager. After 24 hours verbal notice to the Contractor from the Construction Manager, where the Contractor fails to provide timely clean-up, the Construction Manager will at a straight time rate of $55.00/hour adjusted accordingly to reflect over-time requirements, plus any materials and equipment at a cost of 10%, have the clean-up performed by others. A deductive change order or back charge shall be issued to the Contractor to cover the cost of performing such work.
B. During the course of the work, the Construction Manager may determine that it is in the best interest of the job progress to establish a composite cleanup crew for removal of trash and debris. Each Contractor shall provide an allowance equal to one half percent (1/2%) of their overall all contractor amount for providing Labor work on a composite clean-up crew at the direction of the Construction Manager for general clean-up of the project and project site. This allowance is for work above and beyond daily clean-up of your own materials and is to be used only at the direction of the Construction Manager. This is to be setup at a rate of $ 55/hour and shall be listed on the Schedule of values for approval, unused portions of this allowance will be credited back to the Owner through a deductive CO. Contractors are responsible for reporting to field manager prior to performing composite clean-up work to be appropriately credited against their allowance.

1.02 DISPOSAL REQUIREMENTS
A. Conduct cleaning and disposal operations to comply with Scope of work, codes, ordinances, regulations, and anti-pollution laws.
B. Disposal of Materials off site in accordance with applicable laws and as required by agencies having jurisdiction.
C. Contractors are required to remove construction waste from building at the end of each work day.

1.03 MATERIALS
A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
B. Use only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned.
C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.
1.04 DURING CONSTRUCTION
A. Each separate Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by his operations or his subcontractor’s operations. The Construction Manager will oversee cleaning and ensure that building and grounds are maintained free from accumulations of waste materials and rubbish. Do not allow waste materials, rubbish and debris to accumulate and become an unsightly or hazardous condition. In the event that this occurs, the Construction Manager will give the subcontractor twenty four (24) hours verbal notice to clean. At the end of the twenty four (24) hours notice, the Construction Manager will proceed to have the area cleaned and will hold the Contractor responsible for such costs.
B. Each Contractor shall include in his bid the provision for labor, material and Equipment as described above, to work on a composite crew made up of labors from all contractors to work at the direction of the Construction Manager for building and site cleanup.
C. The Construction Manager will provide a Dumpster and locate it on site for collection of waste materials, rubbish and debris. Each contractor needs to consult their specific Bid Package Scope of Work as some contractors are required to provide for their own waste material, rubbish and debris disposal as part of their contract with the owner.
D. Transport waste materials in a controlled manner with as few handling as possible; do not drop or throw materials from heights. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces. Sprinkle dusty debris with water.
E. Burning or burying of rubbish and waste materials on the project site is not permitted. Disposal of volatile fluid wastes (such as mineral spirits, oil, or paint thinner) in storm or sanitary sewer systems is not permitted. Remove waste materials, rubbish and debris from the site and legally dispose of at public or private dumping areas off the Owner’s property.
F. The Contractor shall be responsible to wash the Mud, Gravel, or other debris off their vehicles (including vehicles operated by their employees, vendors, suppliers, and subcontractors) prior to entering or leaving the site. The Contractor will clean immediately from roads, drives, slabs, parking lots, etc. any mud, debris, etc as a result of the operations of their work. The Construction Manager has the right to cleanup surrounding roads immediately upon Contractor’s failure to do so, the cost of which shall be deducted from the Contractor’s contract.

1.05 DUST CONTROL
A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.
C. Broom clean interior building areas when ready to receive finish painting and continue cleaning on as-need basis until building is ready for acceptance or occupancy.

1.06 FINAL CLEANING
A. At completion of construction and just prior to acceptance or occupancy the Construction Manager will conduct a final inspection of exposed interior and exterior surfaces. Perform final cleaning and maintain cleaning until building or portion thereof, is accepted by Owner.
B. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from interior and exterior surfaces. Repair, patch and touch-up marred surfaces to match adjacent finishes. Broom clean paved surfaces; rake clean other surfaces of grounds.
C. Clean all glass and all other finish surfaces, replace all broken and scratched glass; remove stains, spots, marks and dirt from decorated work; clean all hardware; remove paint spots and smears from all surfaces, clean all fixtures and wash or vacuum all
floors; leaving work in a clean and spotless condition.

D. Mechanical subcontractor shall replace air conditioning filters if units were operated during construction. Clean ducts, blowers and coils if air conditioning units were operated without filters during construction.

E. Remove all waste materials and rubbish from and about the Project as well as all tools, construction equipment, machinery and surplus materials.

F. Use experienced workmen or professional cleaners for final cleaning.

G. Comply with cleaning instructions contained in the Specifications. In absence of specific cleaning instructions, follow accepted cleaning practices or the recommendations of the manufacturer of the material to be cleaned.

END OF DOCUMENT
017419
1. SUMMARY
   A. This Section specifies administrative and procedural requirements for a project closeout, including but not limited to:
      I. Project closeout conference.
      II. Substantial Completion and punch list procedures.
      III. Final completion and final payment.
      IV. Project record document submittals.
      V. Operations and maintenance manual submittals.
      VI. Project key submittals.
      VII. Final cleaning.
      VIII. Demonstration of systems and equipment operation to Owner.
      IX. Submittal of Contractor's affidavits and warranties.
      X. One year correction period walk through.
   B. Closeout requirements for specific construction activities are included in the appropriate Sections of the Specifications.

2. PROJECT CLOSEOUT CONFERENCE
   A. The Construction Manager will schedule Project Closeout Conferences at the Project Site, at a time convenient to the Owner, Architect and Contractors prior to the date established for Substantial Completion.
      I. Refer to individual Bid Package - Scopes of Work.
   B. Reporting: Construction Manager will distribute copies of the minutes to each party present and to other parties responsible for work remaining to be completed. Distribute minutes no later than five (5) calendar days after date of conference.

3. SUBSTANTIAL COMPLETION
   A. General: Additional provisions related to Substantial Completion and Partial Occupancy and Use are included in General Conditions, Paragraphs 9.8 and 9.9.
      I. The Construction Manager, and each Contractor shall carefully and regularly check their work for conformance with the Contract Documents. Unsatisfactory work shall be corrected as the work progresses and not be permitted to remain nor become a part of the punch list.
   B. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List any exceptions in the request.
      I. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the Work or portion thereof that the Owner has agreed to accept.
         a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
      II. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
      III. Construction Manager shall obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include building and fire department occupancy permits, operating certificates, health department and boiler inspections and similar releases.
      IV. Submit project record documents, maintenance manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information.
      V. Deliver tools, spare parts, extra stock, and similar items.
      VI. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner’s personnel of changeover in security provisions.
      VII. Complete startup testing of systems and instruction of the Owner’s operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.
   C. Inspection Procedures: Notify the Construction Manager, in writing, when the Work or
designated portion thereof is ready for the punch list inspection. On receipt of a request for inspection and Construction Manager’s punch list, the Architect assisted by the Construction Manager will either proceed with inspection at the earliest possible date or advise the Contractor of unfilled requirements. The Construction Manager will prepare the Certificate of Substantial Completion following inspection or advise the Contractor of construction that must be completed or corrected, as indicated on the punch list, before the certificate will be issued.

I. Results of the completed inspection will form the basis of requirements for final acceptance.
   a. Upon receipt of the punch list, each Contractor shall within seven (7) days advise the Architect of any questions that they may have concerning the requirements of the punch list.

II. When advised by the Construction Manager that the punch list items are completed or corrected, the Architect assisted by the Construction Manager will conduct a re-inspection of the Work or designated portion thereof with the Contractors, any needed subcontractors, and the Owner's Representative where applicable, to determine whether the Certificate of Substantial Completion can be issued.
   a. If, upon the second re-inspection, it is found that punch list items are not sufficiently complete, the Contractors shall be responsible for the Owner's costs for additional architectural and engineering services for preparation of a new punch list and any subsequent re-inspection prior to issuance of the Certificate of Substantial Completion. The Owner's costs for additional services of the Architect, Construction Manager and their Consultants will be deducted from Contractor's contract through an appropriate Change Order at the rate of $100.00 per hour per individual, plus applicable reimbursable expenses.

III. When issued, the Certificate of Substantial Completion shall name the date, triggering the beginning of the warranty period, with any items to have a later starting date specifically noted. The Certificate shall also have attached to it the uncompleted punch list items, and shall name the date for their completion.

IV. Acknowledgment of the Date of Substantial Completion by the signature of all parties on the Certificate implies possession of the Work or designated portion thereof by the Owner, and completion of incomplete punch list items by the Contractor and the subcontractors at the Owner's convenience. The Owner shall cooperate in permitting the Contractors access to the work for the completion of punch list items.

D. Punch List Completion Period: Date of Substantial Completion shall trigger a thirty (30) day period for each Contractor's completion of all outstanding punch list items remaining to be complete and corrected. When the Contractor feels he has completed his punch list items, he is to notify the on-site Construction Manager's representative. The Construction Manager's representative will make an inspection with a representative of the said Contractor present. All items complete will be initialed by the Construction Managers representative and a copy given to the Contractor.
   i. After thirty (30) days, the Owner reserves the right to complete work and deduct all costs relating to the completion, including labor material, administration costs, supervision costs and any other costs incurred as a result of having to compete the work and deduct this cost from the retainage being withheld. Written notice will be sent to the Contractor at the end of the thirty (30) days listing the items remaining incomplete. No other notice will be given before scheduling the work to be completed by others.

4. FINAL ACCEPTANCE AND FINAL PAYMENT

A. General: Additional provisions related to Final Completion and Final Payment are included in the General Conditions, paragraph 9.10.
   i. Refer also to individual Bid Package - Scope of Work for additional requirements.

B. Preliminary Procedures: Before requesting final payment, and as required by individual Bid Package – Scope of Work, complete the following Project Closeout Checklist items. List exceptions in the request.
   i. Complete final cleanup requirements, including touch-up painting.
   ii. Touch up and otherwise repair and restore marred, exposed finishes.
   iii. Submit the final payment request with releases, project record documents, operations and
maintenance manuals, and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.

IV. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

V. Submit two (2) certified copies of the Architect’s final punch list. The certified copy of the punch list shall verify that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Contractor and Construction Manager.

VI. Submit a measured record of stored fuel, and similar data as of the date of Substantial Completion or when the Owner took possession of and assumed responsibility for corresponding elements of the Work.

VII. Submit Final Affidavits and Final Lien Waiver.

VIII. Submit Consent of Surety to Final Payment.

IX. Submit certificate of final or continuing insurance coverage.

X. Asbestos-free letter: Refer to Document 008400 for sample form.

C. Re-inspection Procedure: The Architect and Construction Manager will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Architect.

I. Upon completion of re-inspection, the Architect will prepare a certificate of final acceptance. If the Work is incomplete, the Architect will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

D. Project Closeout Period: Date of Substantial Completion shall trigger a thirty (30) day “Closeout Period” for each Contractor’s submittal and acceptance of all closeout submittals as listed in Article 1.2 of this Section in addition to Asbestos-Free Letter, Consent of Surety, Project Completion Certificate, Contractors Affidavit, Certificate of Substantial Completion (forms to be furnished to Contract at Substantial Completion), and written warranty/guaranty, operation and maintenance manual, Final Lien Waiver. All closeout documents must be submitted to the Construction Manager within thirty (30) days of established Substantial Completion date.

I. A $100.00 per calendar day penalty will be accessed for any closeout submittals received after thirty (30) day Project Closeout period. The penalty will be deducted from the retainage being withheld. Only if written authorization from the Construction Manager to extend this time frame can this per day penalty not be enforced.

E. Materials purchased for incorporation in this Project are exempt from certain taxes pursuant to the Exemption letter issued by the State of Missouri for this Project.

I. Failure to use the granted tax exemption properly can result in civil and criminal penalties.

II. Subcontractor or Supplier hereby agrees to indemnify Contractor and Owner for any loss, damage, cost or penalty assessed against them by the State of Missouri arising from Subcontractor’s or Supplier’s improper implementation of the tax exemption granted to this Project.

5. PROJECT RECORD DOCUMENT SUBMITTALS

A. Reference Section 017839

6. OPERATIONS AND MAINTENANCE MANUAL SUBMITTALS

A. Reference Section 017823

7. PROJECT KEYS

A. When project is completed, turn over temporary construction keys to Owner for Owner to provide permanent keying. Advise Owner’s personnel of change-over in security provisions.

8. FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions, Paragraph 3.15, and individual sections of the specification.

I. Refer to individual Bid Package - Scope of Work for requirements.

B. Cleaning: As set forth in individual Scopes of Work, clean each surface or unit to the condition
expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

I. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
   a. Remove labels that are not permanent labels.
   b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
   c. Finished surfaces: Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Remove marks, fingerprints and other soil and dirt from painted, glazed, decorated, stained or otherwise finished surfaces including ceilings. Restore reflective surfaces to their original condition. Remove construction dust from horizontal and vertical surfaces including shelves and cabinet tops. Repaint or refinish as required to restore surfaces to "as new" quality.
   d. Carpet and hard surfaces floors: Thoroughly vacuum and clean carpets. Dust and dry-mop all hard surfaced floors.
      i. Remove stains, spots and soil utilizing methods recommended by carpet/hard surface flooring material manufacturer to prohibit damaging of material.
      ii. Fixtures and mechanical/electrical equipment: Remove stains, paint droppings, spots, dirt, etc., from electrical fixtures, plumbing fixtures, mechanical and electrical equipment, casework, furnishings, etc.
   e. Site: Clean the site, including landscape development areas, of rubbish, erosion control devices, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.

C. At completion of the work, remove all temporary facilities, trash and debris from building. Leave buildings clean, neat, and ready for occupancy. Provide all facilities and dumpsters necessary to remove trash and debris.

D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner’s property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.
   I. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner.

9. DEMONSTRATION OF OPERATION AND MAINTENANCE TO OWNER
   A. Reference Section 017900

10. CONTRACTOR’S AFFIDAVITS
    A. Reference section 9.1.3 of 022000 Supplemental Instruction to Bidders for listing of Contractors Affidavits. Reference Section 084000 for blank forms for some of these documents. AIA documents must be obtained through AIA.

11. WARRANTIES
    A. Beneficial Use of Equipment: No equipment will be turned over to the Owner prior to Date of Substantial Completion without the written authorization of the Construction Manager. If the Construction Manager approves Owner's use of equipment before the Date of Substantial Completion, the warranty for such equipment shall be extended to cover the specified period commencing at Date of Substantial Completion.
    B. Warranty: All warranties shall commence from the Date of Substantial Completion unless Owner is receiving beneficial use of warrantee equipment prior to this date as defined above and agreed to by the Owner.

12. ONE YEAR CORRECTION PERIOD WALK THROUGH
    A. A One Year Correction Period Walk Through will be made by the Construction Manager, Architect and Owner’s representative. Contractors will be notified in writing of the items which
apply.

I. The items listed must be complete within thirty (30) days on the date on said notification.

B. Upon completion of said list the Contractor is to contact the Construction Manager. A meeting will be set up to make an inspection of the completed work. All items completed will be initialed on the Construction Managers master list and a copy given to the Contractor.

I. After thirty (30) days the Owner reserves the right to complete work. All costs relating to the completion including labor, material, administration costs, supervision costs and any other costs incurred as a result of having to complete the work will be claimed against the Contractor’s Bond. Written notice will be sent to the Contractor at the end of the thirty (30) days listing the items remaining uncompleted. No other notice will be given before scheduling the work to be completed by others.

END OF DOCUMENT
017700
DOCUMENT 017823 – OPERATION AND MAINTENANCE DATA

1. GENERAL
   A. Compile Manufacturer’s Directions and Manuals, Product Data and related information appropriate for Owner’s maintenance and operation of products furnished under the Contract.
      I. Furnish operating and maintenance data as specified in other pertinent sections of Specifications.
   B. Provide Training of Owner’s personnel in the maintenance of products and in the operation of equipment and systems.
   C. Each Contractor will provide a Video Recording of training sessions for the owner’s future use.

2. FORM SUBMITTALS
   A. Prepare data in the form of an instructional manual for use by Owner’s personnel.
   B. Provide indexed tabs fly-leaf for each separate product, or each piece of operating equipment.
      Provide typed description of product and major component parts of equipment.
   C. Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS".
   D. Bind in commercial quality three-ring binders with durable and cleanable plastic covers.
   E. When multiple binders are used, correlate the data into related consistent groupings.

3. CONTENT OF MANUAL
   A. Neatly typewritten table of contents for each volume, arranged in a systematic order.
      I. Contractor, name of responsible principal, address and telephone number.
      II. A list of each product required to be included, indexed to the content of the volume.
      III. List, with each product, the name, address and telephone number of:
          a. Subcontractor or installer
          b. Maintenance contractor, as appropriate.
          c. Identify the area of responsibility of each.
          d. Local source of supply for parts and replacement.
      IV. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
   B. Product Data: Include only those sheets which are pertinent to the specific product. Annotate each sheet to:
      I. Clearly identify the specific product or part installed.
      II. Clearly identify the data applicable to the installation.
      III. Delete references to inapplicable information.
   C. Drawings: Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems, and control and flow diagrams.
      I. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
      II. Do not use Project Record Documents as maintenance drawings.
   D. Written text, as required to supplement product data for the particular installation:
      I. Organize in a consistent format under separate headings for different procedures.
      II. Provide a logical sequence of instructions for each procedure.
   E. Copy of each warranty, bond and service contract issued. Provide information sheet for Owner’s personnel, give:
      I. Proper procedures in the event of failure.
      II. Instances which might affect the validity of warranties or bonds.

4. MANUAL FOR MATERIALS AND FINISHES
   A. Submit two (2) copies of complete manual in final form.
   B. Content, for architectural products, applied materials and finishes:
      I. Manufacturer’s data, giving full information on products.
      II. Instructions for care and maintenance.
   C. Content, for moisture-protection and weather-exposed products:
      I. Manufacturer’s data, giving full information on products.
D. Additional requirements for maintenance data: The respective sections of Specifications.

5. MANUAL FOR EQUIPMENT AND SYSTEMS
   A. Submit two (2) copies of complete manual in final form
   B. Content, for each unit of equipment and system, as appropriate:
      I. Description of unit and component parts.
      II. Operating procedures.
      III. Maintenance Procedures.
      IV. Servicing and lubrication schedule.
      V. Manufacturer's printed operating and maintenance instructions.
      VI. Description of sequence of operation by control manufacturer.
      VII. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      VIII. As-installed control diagrams by controls manufacturer.
      IX. Each contractor's coordination drawings.
      X. Charts of valve tag numbers, with the location and function of each valve.
      XI. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
      XII. Other data as required under pertinent sections of specifications.
   C. Content, for each electric and electronic system, as appropriate:
      I. Description of system and component parts.
      II. Circuit directories of panelboards.
      III. As installed color coded wiring diagrams
      IV. Operating procedures.
      V. Maintenance procedures.
      VI. Manufacturer's printed operating and maintenance instructions.
      VII. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
      VIII Other data as required under pertinent sections of specifications.
   D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
   E. Additional requirements for operating and maintenance data: The respective sections of Specifications.

6. SUBMITTAL SCHEDULE
   A. Submit one (1) copy of completed data in final form 15 days prior to final inspection or acceptance.
      I. Copy will be returned after final inspection or acceptance, with comments.
   B. Submit specified number of copies of approved data in final form 10 days after final inspection or acceptance.

7. INSTRUCTION OF OWNER’S PERSONNEL
   A. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems.
   B. Operating and maintenance manual shall constitute the basis of instruction.
   C. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

END OF DOCUMENT
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1. GENERAL RECORDS
   A. Each Contractor shall maintain at the site for the Owner one record copy of:
      I. Drawings
      II. Specifications
      III. Addenda
      IV. Change Orders and other Modifications to the Contract.
      V. Architect/Engineer Field Orders or written instructions.
      VI. Approved Shop Drawings, Product Data and Samples
      VII. Field Test records
      VIII. Construction photographs
      IX. Meeting reports
   B. Each Contractor shall maintain an AS-Built set of drawing on site at all times. These drawings shall be marked-up by each Contractor, throughout the construction period, indicating all changes, revisions and additions to the work, including field relocations of work concealed from view.

2. MAINTENANCE OF DOCUMENTS AND SAMPLES
   A. Store documents and samples in Contractor's field office apart from storage of documents used for construction.
      I. Provide files and racks for storage of documents
      II. Provide locked cabinets or secure storage space for storage of samples.
   B. File documents and samples in accordance with Data Filing Format of the Uniform Construction Index.
   C. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
   D. Make documents and samples available at all times for inspection by Architect.

3. RECORDINGS
   A. Label each document "PROJECT RECORD" in neat large printed letters.
   B. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
   C. Drawings; Legibly marked to record actual construction:
      I. Depths of various elements of foundation in relation to finish first floor datum.
      II. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
      III. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
      IV. Field changes of dimension and detail.
      V. Changes made by Field Order or by Change Order.
   D. Specifications and Addenda; Legibly mark each Section to record:
      I. Manufacturer, trade name, catalog number, and supplier of each Product and item of equipment actually installed.
      II. Changes made by Field Order or by Change Order.

4. SUBMITTAL
   A. At the completion of work, Contractor shall certify, by endorsement thereof, that each of the revised drawings is complete and accurate. Prior to Contractor's application for final payment, and within 45 days of final acceptance of all the work by the Owner, unless otherwise modified by the Contract Agreement, and as a condition of acceptance by the Owner, each Contractor shall deliver the certified Record Documents to the Construction Manager for transmittal to the Architect.
   B. Contractor responsible for submitting electronic copies of all closeout documents through submittal exchange, as well as the required hard copies.
C. At contract close-out, Construction Manager shall deliver record documents to Architect for the Owner.
1. **SUMMARY** - Administrative and procedural requirements for instructing Owner’s personnel:
   Demonstration of operations of systems, subsystems and equipment. Training in operation and maintenance of systems, subsystems and equipment.

2. **QUALITY ASSURANCE** - Instructor Qualifications: A factory-authorized service representative experienced in the operation and maintenance procedures and training.

3. **COORDINATION AND SCHEDULING**
   A. Coordinate instruction schedule with Construction manager and Owner’s operations, at least ten (10) days advance notice. Adjust schedule to minimize disruptions to Owner’s operations. Time and location to be as mutually agreed.
   B. Coordinate instructors, including providing notification dates, times, length of instruction period and course content.
   C. Coordinate content of training modules with content of approved emergency, operations and maintenance manuals.

4. **INSTRUCTION PROGRAM** - Develop a videotaped instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual specification Sections, and including, but not limited to, the following:
   A. Equipment
   B. Fire-protection systems, including fire alarm and fire-extinguishing systems
   C. HVAC systems, including air-handling equipment and air distribution systems
   D. HVAC instrumentation and controls
   E. Electrical service and distribution
   F. Lighting Equipment and Controls

5. **TRAINING MODULES** - Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
   A. Basic System Design, Operational Requirements, and Criteria: Include the following:
      I. System, subsystem, and equipment descriptions
      II. Performance and design criteria (if Contractor is delegated design responsibility)
      III. Operating Standards
      IV. Regulatory requirements
      V. Equipment function
      VI. Operating characteristics
      VII. Limiting conditions
      VIII. Performance curves
   B. Documentation: Review the following items in detail:
      I. Emergency manuals
      II. Operations manuals
      III. Maintenance manuals
      IV. Preventive Maintenance requirements
      V. Project Record Documents
      VI. Identification Systems
      VII. Warranties and bonds
      VIII. Maintenance service agreements and similar continuing commitments
   C. Emergencies: Include the following, as applicable:
      I. Instructions on meaning of warning, trouble indications, and error messages
      II. Instructions on stopping equipment
      III. Shutdown instructions for each type of emergency
      IV. Operating instructions for conditions outside normal operating limits
      V. Sequences of electric and electronic equipment and systems
VI. Special operating instructions and procedures

D. Operations: Include the following, if applicable:
   Start-up procedures
   I. Equipment or systems break-in procedures
   II. Routine and normal operating instructions
   III. Regulation and control procedures
   IV. Control sequences
   V. Safety procedures
   VI. Instructions in stopping
   VII. Normal shutdown procedures
   VIII. Operating procedures for emergencies
   IX. Operating procedures for system, subsystem, or equipment failure.
   X. Seasonal and unoccupied operating instructions
   XI. Required sequences for electric or electronic equipment or systems
   XII. Special operating instructions and procedures

E. Adjustments: Include the following:
   I. Alignments
   II. Checking Adjustments
   III. Noise and vibration adjustments
   IV. Economy and efficiency adjustments

F. Troubleshooting: Include the following:
   I. Diagnostic instructions
   II. Test and inspection procedures

G. Maintenance: Include the following:
   I. Inspection procedures
   II. Types of cleaning agents to be used and methods of cleaning
   III. List of cleaning agents and cleaning methods detrimental to product
   IV. Procedures for routine cleaning
   V. Procedures for preventive maintenance
   VI. Procedures for routine maintenance
   VII. Instruction in use of special tools

H. Repairs: Include the following:
   I. Diagnosis instructions
   II. Repair instructions
   III. Disassembly; component removal, repair and replacement, and reassembly instructions
   IV. Instruction for identifying parts and components
   V. Review of spare parts needed for operation and maintenance.

6. PREPARATION
   A. Assemble educational materials for instruction, including documentation and training module.
   B. Set up instructional equipment at instruction location.
   C. Set up video recording system and record entire training session and provide Owner with copy of recording at end of session.

7. INSTRUCTION
   A. Instructors shall demonstrate to Owner’s personnel to adjust, operate and maintain systems, subsystems and equipment ancillary or controlling to their system, even if provided by other vendors.
   B. Video record all training sessions and provide copy to Owner at completion of session.

END OF DOCUMENT
017900
SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Intent: The intent of this Section is to provide finish hardware for the proper operation and control of all wood, hollow metal and aluminum doors in the Project. Prior to bidding, notify the Architect of any doors that do not have hardware meeting this intention.

B. This Section includes items known commercially as finish or door hardware that are required for swinging doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed. This Section includes, but is not necessarily limited to furnishing and installing complete, the following:
   1. Finish hardware for proper operation and control of all wood, aluminum and hollow metal doors, including hinges, locks and latch sets, closers, panic devices, auto-flushbolts, electric strikes, magnetic holders, removable mullions, cylinders, keys, miscellaneous stops, flat goods, weatherstripping and thresholds as required.
   2. Cylinder for access doors where specified.

C. Related work in other sections:
   1. Hollow metal doors, frames and silencers: Section 081113.
   2. Wood doors: Section 081416.
   3. Aluminum doors: Section 084113.

1.2 DEFINITIONS

A. "Finish Hardware" includes items known commercially as finish hardware which are required for swing, and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturers technical product data for each hardware item. Include information necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finishes.
   1. Manufacturer shall submit written certification confirming closers compliance with U.L. 10C.

B. Hardware Schedule: Submit a hardware schedule in a vertical format (horizontal format not acceptable), organized into sets, including the information below. Designations for door numbers and hardware sets in the schedule shall match those used in the Construction Documents for each opening.
   1. Hardware Schedule shall be coordinated with doors, frames, and related work to ensure proper size, thickness, hand function, and finish of door hardware.
   2. Catalog cuts of each type of exposed hardware unit, highlighted in color to indicate compliance with the Hardware Schedule.
   3. Type, style, function, size and finish of each hardware item.
   4. Name and manufacturer of each item.
   5. Fastenings and other pertinent information.
   6. Explanation of all abbreviations, symbols, codes, etc., contained in schedule.
   7. Mounting locations for hardware.
   8. Door and frame sizes and materials.
   9. Deviations from Specifications shall be noted in cover letter.

C. Submittal Sequence: Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.
D. **Keying Schedule**: Submit separate detailed schedule, at the same time as the Hardware Schedule, indicating keying for all locks and how Owner's instructions, on keying of locks has been fulfilled. Keying schedule must be approved before ordering any locks.

E. **Pinning Transcript**: Submit detailed schedule indicating each lock cylinder and core.

F. **Templates**: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

G. **LEED Certification Points**: Submit information and certifications necessary to achieve maximum points for LEED certification; coordinate and cooperate with Owner and Architect in providing information necessary for required LEED rating.

1.4 **QUALITY ASSURANCE**

A. **Manufacturer**: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.

B. **Product/Material Qualifications**: Manufacturer's product numbers are indicated for convenience in identifying finish hardware items. Unless otherwise indicated, manufacturer's description for indicated product number constitutes minimum standards of quality, design, function and performance required for each item to be incorporated into the Project.

   1. It will be the responsibility of the Bidder to furnish with his Bid a list clarifying any deviations from these specifications written or implied, in order that a fair and proper evaluation be made. Those Bidders not submitting a list of deviations will be presumed to have Bid as specified.

C. **Supplier Qualifications**: A recognized Architectural Finish Hardware Supplier, with warehousing facilities, who has been furnishing hardware in the project's vicinity for a period of not less than 2 years. Supplier shall be or employ an experienced Architectural Hardware Consultant (AHC) who is certified by and member of the Door and Hardware Institute. The Architectural Hardware Consultant shall be available, at reasonable times during the course of the work, for consultation about project's hardware requirements, to Owner, Architect and Contractor.

   1. Supplier shall meet with the Owner to finalize keying requirements and obtain final instructions in writing.

D. **Fire-Rated Openings**: Provide hardware for fire-rated openings in compliance with NFPA Pamphlets No. 80, No. 101 and of authorities having jurisdiction requirements. Provide only hardware which has been tested and listed by UL, FM or Warnock Hersey for types and sizes of doors required and complies with requirements of door and door frame labels.

   1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL or FM labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL or FM label on exit devices indicating "Fire Exit Hardware".

E. **Standards**: Comply with the requirements of the latest edition of the following standards, unless indicated otherwise:
   1. **American National Standards Institute (ANSI) Publications**:
      1. A115 Series - Door and Frame Preparation.
      2. A156 Series - Hardware.
   2. **Builders Hardware Manufacturers Association (BHMA) Publications**:
      1. 1201 - Auxiliary Hardware.
      2. 1301 - Materials and Finishes.
   3. **Door and Hardware Institute (DHI) Publications**:
      2. Abbreviations and Symbols.
      3. Hardware for Labeled Fire Doors.
      4. Recommended Locations for Builder's Hardware for Standard and Custom Steel Doors and Frames.
   4. **National Fire Protection Association (NFPA) Publications**:
      1. NFPA Pamphlet No. 80 - Standards for Fire Doors and Windows.
   6. **Americans with Disabilities Act (ADA)**.
F. Keying Conference: Conduct conference in accordance with Section 013100. In addition to Owner, Construction Manager, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Address for delivery of keys.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Section 013100 as follows:
1. Architectural Finish Hardware supplier (AFHS) shall conduct the preinstallation conference at the site. The AFHS shall instruct finish hardware installer on proper installation, adjustment and troubleshooting for each operable item of finish hardware specified. The AFHS shall observe the installation and adjustment of the first three locksets, closers and exit devices.

1.5 DELIVERY, STORAGE AND HANDLING
A. Package each hardware item in separate containers with all screws, wrenches, installation instructions and installation templates. Mark or tag each box with hardware heading and door number according to approved hardware schedule.
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. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation. Provide a complete packing list showing items, door numbers and hardware headings with each shipment.
D. Store hardware in shipping cartons above ground and under cover to prevent damage.
1. Provide secure lockup 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.
E. Aluminum Door Hardware: If required by door manufacturer deliver hardware for aluminum doors as directed by the door supplier for factory installation.

1.6 COORDINATION
A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing 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.
B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system, as applicable.

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

2.1 HARDWARE - GENERAL

A. Provide the materials or products indicated by trade names, manufacturer's name, or catalog number.

B. Provide manufacturer's standard products meeting the design intent of this Specifications, free of imperfections affecting appearance or serviceability.
   1. 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 for finish designations indicated.
   2. Provide hardware complete with all fasteners, anchors, instructions, layout templates, and any specialized tools as required for satisfactory installation and adjustment.
   3. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
   4. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated or approved. Finish screws exposed under any condition to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible.
   5. Finish all other hardware in accordance with the BHMA finish as follows, unless otherwise indicated in manufacturers screws to secure hardware.
   6. Provide concealed fasteners for hardware units which are exposed when door is closed, except to 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, except where indicated otherwise or where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex bolt fasteners.
   7. Provide factory pinned cylinders and cores.

C. Hardware is specified in the hardware schedule by set, type, and functions which have been selected as best meeting the application requirements. Acceptable products for each category are specified under PART 2 of this Specification.

2.2 SPECIAL REQUIREMENTS

A. Hinges:
   1. Provide non-removable pins for all exterior doors and out-swinging corridor doors. Use nonrising pins for all other doors.
   2. Pre-drill pilot holes for hinge fasteners at factory to suit hinge type.
   3. Provide continuous hinges where specified.

B. Locksets:
   1. All locksets shall meet or exceed ANSI A156.13-94, Grade 1 requirements.
   2. Provide stainless steel finish where specified.

C. Panic Devices:
   1. All panic devices shall have touchbars made of stainless steel, provide devices in stainless finish where specified.
   2. All latchbolts are to be deadlatching.
   3. Exit devices are to incorporate a flush and tapered end cap.
   4. Exit device trim to match that of corresponding lockset.
   5. Hardware mullions are to be of the same manufacturer as the panic device. Provide keyed mullions unless otherwise specified. Provide mullion storage kits where specified.
   6. Devices incorporating plastic dogging components will not be allowed.
   7. Provide electrical options as specified.

D. Closers:
   1. Comply with manufacturer's recommendations for unit size based on door size, weather exposure and usage.
   2. Provide parallel arms for all overhead closers, except as otherwise indicated.
   3. All surface closers shall exceed ANSI A156.4 Grade 1 requirements in all aspects as called for below. All closers shall have certification by an independent testing laboratory of 10,000,000 cycles without failure. Provide special rust inhibitive primer (SRI) where specified.
4. Furnish all brackets, drop plates and any other necessary hardware required to insure proper installation.

E. Stops
   1. Provide heavy duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide overhead stop for interior doors that swing more than opens against equipment, casework, sidelights, and where conditions do not allow wall stop.

F. Thresholds and Gasketing
   1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
   2. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
   3. Gasketing and astragals on aluminum frames by door manufacturer.

G. Silencers
   1. Provide "push-in" type silencers for hollow metal or wood frames.
   2. Provide one silencer per 30 inches of height on each single frame, and two for each pair frame.
   3. Omit where gasketing is specified.

2.3 KEYING

A. All cylinders to be keyed to the districts existing Schlage master system. Hardware supplier to verify proper key system. Keying schedule must be approved by the Owner prior to ordering locks.
   1. Hardware supplier shall be responsible for providing the correct type of cylinder for each hardware application, and supplying cylinder with correct tailpiece and/or cam.
   2. Provide removable cores where specified.

B. All keying shall be accomplished at hardware manufacturer's plant where adequate records are maintained in order to avoid duplication of changes.

C. Key all locks separately, or alike, as directed by the Owner's representative and Architect.

D. Provide keys as follows:
   1. Change Keys: Two (2) per lock.
   2. Master Keys: Six (6) required (per system).

D. Identification: Stamp all (master-type) keys with the following:
   1. Do Not Duplicate.
   2. Key change number (all keys).

2.4 KEY CONTROL SYSTEM

A. Key Control System Manufacturers:
   1. Scheduled Manufacturer: Telkee
   2. Acceptable Manufacturers: HPC, Lund

B. Requirements:
   1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
   2. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
   3. Provide hinged-panel type cabinet for wall mounting.

C. Fire Department Access Boxes:
   1. Provide key lock boxes designed for storage of 2-5 keys. Manufactured by Knox Company or equal.
   2. Provide one lock box at exterior and provide one near elevators, if applicable.
   3. Locate in accordance with architectural detail. Where not specifically indicated, locate as directed by Architect.
   4. Provide surface mounted or recessed based on direction from Architect.
2.5 HARDWARE FINISHES

A. Provide matching finishes for hardware units at each door to the greatest extent possible, unless otherwise indicated. In general, match items to the finish for the latch, lock or push-pull unit for color and texture.

1. Product description or schedule:
   1) 626 satin chrome-plated.
   2) 630 satin stainless steel.

2.6 HARDWARE PRODUCTS

A. Hinges:
   1. Specified manufacturer: IVES Hardware; an Allegion Company.
   2. Acceptable substitutions:
      1. Hager Companies.
      2. McKinney Products Company; an ASSA ABLOY Group company.
      3. Stanley Commercial Hardware; Div. of The Stanley Works.

B. Continuous Gear-Type Hinges:
   1. Specified manufacturer: IVES Hardware; an Allegion Company.
   2. Acceptable substitutions:
      1. Hager Companies.
      2. McKinney Products Company; an ASSA ABLOY Group company.
      3. Select Products Limited.

C. Locksets:
   1. Specified manufacturer: Schlage Commercial Lock Division; an Allegion Company.

D. Exit Devices:
   1. Specified manufacturer: Von Duprin; an Allegion Company

E. Closers:
   1. Specified manufacturer: LCN Closers; an Allegion Company.

F. Flatgoods:
   1. Specified manufacturer: Ives Hardware; an Allegion Company.
   2. Acceptable substitutions:
      1. Burns.
      2. Rockwood.

G. Stops:
   1. Specified manufacturer: Ives Hardware; an Allegion Company.
   2. Acceptable substitutions:
      2. Hager Companies.
      4. Trimco

H. Overhead stops:
   1. Specified manufacturer: Glynn-Johnson; an Allegion Company.
   2. Acceptable substitutions:
      1. Architectural Builders Hardware Mfg., Inc.
      2. Door Controls International.
      3. Ives Hardware; an Allegion Company.
      4. Rixson Specialty Door Controls; an ASSA ABLOY Group.

I. Thresholds:
   1. Specified manufacturer: Zero International
   2. Acceptable substitutions:
      1. Pemko Manufacturing Co.
      2. Reese Enterprises.
      3. National Guard Products.
J. Door Gasketing:
1. Specified manufacturer: Zero International
2. Acceptable substitutions:
   1. Pemko Manufacturing Co.
   2. Reese Enterprises.
   3. National Guard Products.

K. Weatherstriping:
1. Specified manufacturer: Zero International
2. Acceptable substitutions:
   1. Pemko Manufacturing Co.
   2. Reese Enterprises.
   3. National Guard Products.

PART 3 - EXECUTION

3.1 PREPARATION
A. Carefully inspect doors, frames, and conditions under which hardware will be installed. Notify the Architect of any conditions that would adversely affect the installation or subsequent door operations. Do not proceed until unsatisfactory conditions are corrected.
   1. Frames shall be verified, inspected, and confirmed by General Contractor as being plumb and true.
B. Refer to Sections 081113, 081416, and 084113 for additional installation requirements.
C. Prior to hardware installation, the Hardware Supplier shall meet with the Owner's Representative, Architect, and Hardware Installer to ensure the Installer has and understands the manufacturers' installation requirements for all hardware items.
   1. The Supplier shall observe the installation of the first lockset, closer and panic device.

3.2 INSTALLATION
A. Mount Hardware units at heights indicated in respective DHI Standards, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.
B. Install each hardware item in compliance with the manufacturer's instructions and written recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be field finished, coordinate removal, storage and reinstallation or application of surface protections with finishing work. Do not install surface-mounted items until finishes have been completed on the substrate.
C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
   1. Special care shall be taken to avoid damaging surrounding surfaces.
D. Provide fasteners and anchoring devices of suitable size, quantity, and type to secure hardware in proper position for heavy use and long life.
   1. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
E. Adjust door closers immediately upon installation. Adjust in exact conformance with manufacturer's printed instructions. Advance backcheck to eliminate shock at dead stop. Set latching speed to assure unassisted positive latching.
   1. Degrees of swing of doors for self-limiting closers shall be maximum available.
F. Install each protection plate with a thinly-spread spot of mastic at its center to assure even contact before fastening with screws. Install all such plates on visual centers of closed doors. Set bottom edges of all such plates flush with door bottom.
G. Cut and fit thresholds to door frame profiles. Prepare thresholds for the attachment of strikes and clearance for spindles as required. Set thresholds in a continuously laid bed of polyisobutylene mastic sealant to completely fill voids and exclude moisture from every source.
H. Seal weather protection components attached to the exterior sides of doors and frames, such as drip caps and weatherstripping, in place with clear silicone caulk in such a manner as to ensure a continuously filled seam throughout the joinery.

I. Cut and fit weatherstripping accurately to provide the greatest possible continuity of the contact element. Adjust closer templating as required.

J. At exterior doors, obtain satisfactory operation of the installation, then apply a thin layer of clear silicone caulk under hinge leaves, and outside lock trim. Remove excess caulk after torquing fasteners.

3.3 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
   1. Clean adjacent surfaces soiled by hardware installation.

B. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work 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.

3.4 INSTRUCTION AND INSPECTION

A. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

B. After hardware is installed and adjusted, the Supplier shall inspect the job with the Architect and the Contractor to determine if the hardware is functioning properly.
   1. Maintain the instruction sheets, layout templates, and any supplementary literature regarding hardware in a readable condition. Transmit all such items to the Owner's Representative, together with all spare parts, specialized tools, other accessories supplied with the hardware, and a copy of the approved hardware schedule at the time of instruction.

C. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units at no cost to the Owner. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.
HARDWARE SET 01

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OPERATION: DOOR NORMALLY CLOSED AND LOCKED. ACCESS VIA VALID CARD READ. PANICS MAY BE DOGGED (MADE PUSH/PULL) ELECTRONICALLY. ALWAYS FREE EGRESS.

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OPERATION: DOOR NORMALLY CLOSED AND LOCKED. ACCESS VIA VALID CARD READ. PANICS MAY BE DOGGED (MADE PUSH/PULL) ELECTRONICALLY. ALWAYS FREE EGRESS.
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OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PANICS MAY BE DOGGED (MADE PUSH/PULL) ELECTRONICALLY. ALWAYS FREE EGRESS.

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OPERATION: DOOR NORMALLY CLOSED AND LOCKED. VALID CARD READ OR PUSHBUTTON AT DESK ALLOW TEMPORARY ENTRY. ALWAYS FREE EGRESS.
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**OPERATION:** DOOR NORMALLY CLOSED AND LOCKED. VALID CARD READ OR PUSHPUTTON AT DESK ALLOW TEMPORARY EXIT FROM OFFICE. CORRIDOR SIDE LOCKED/UNLOCKED MECHANICALLY. ALWAYS FREE EGRESS.

### HARDWARE SET 06

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**NOTE**

REMAINDER OF HARDWARE EXISTING

**OPERATION:** DOOR NORMALLY CLOSED AND LOCKED. VALID CARD READ ALLOWS TEMPORARY ENTRY. ALWAYS FREE EGRESS.
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**OPERATION:** DOOR NORMALLY CLOSED AND LOCKED. VALID CARD READ OR PUSHBUTTON AT DESK ALLOW TEMPORARY ENTRY. ALWAYS FREE EGRESS.

### HARDWARE SET 08

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(At Rated Openings)

(At Non-Rated Openings)

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(At Rated Openings)

(At Non-Rated Openings)
HARDWARE SET 13

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### DOOR/HARDWARE INDEX

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D112A | 07
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F101  | 17
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END OF SECTION
SECTION 01400 – FOOD SERVICE EQUIPMENT

Park Hill South High School Remodel - 2018  
Division 11400  
Food Service Equipment Specifications

Item #1  Dunnage Racks: One (1) Lot Required  
A. New Age Industrial 2000 Series Dunnage Racks  
   (01) #2016 24” x 8” x 60”  
   (01) #2032 24” x 8” x 72”

Item #2  Can Racks: Two (2) Required  
A. New Age Industrial Model #1250CK  
   A. Furnish standard unit with casters

Item #3  Track Shelving: One (1) Lot Required  
A. InterMetro Industries MetroMax Q Top Track Shelving to consist of:  
   (01) #MQTTE24 Top Track Stationary End Kit  
   (10) #MQTTM24C Top Track Mobile Unit Kit  
   (01) #MQTTA24 Top Track Stationary Intermediate Unit  
   (02) #TTS13NA Top Track Set, 13'-0”  
   (52) #MQ2460G 24” x 60” shelves

Item #4  Mobile Shelving: One (1) Lot Required  
A. InterMetro Industries MetroMax Q posts and shelves to consist of:  
   (16) #MQ2460G 24” x 60” shelves  
   (16) #MQ74UPE 74” posts  
   (16) #5PCBX 5” swivel casters with brakes

Item #5  Mobile Spice Shelf: One (1) Required  
A. Intermetro Industries MetroMax Q posts and shelves to consist of:  
   (03) #MQ1824G 18” x 24” shelves  
   (04) #MQ33UPE 33” posts  
   (04) #5PCBX 5” swivel caster with brakes

Item #6  Mop Sink: By Plumbing Contractor

Item #7  Hot Water Dispenser w/Stand  
A. Bunn Model #H5X-DV PC 212, 120v/208v/1Ø  
   1. Furnish standard 5 gallon unit  
   2. Unit to be dual voltage for either 120v or 208v connection  
   3. Furnish with Drip Tray Kit  
   4. Furnish with #EQHP-10L water filter  
B. Dispenser Stand  
   1. Advance Tabco Model #TFMSU-180

Item #8  Lexan Pan Storage: One (1) Lot Required  
A. InterMetro Industries MetroMax Q posts and shelves to consist of:  
   (08) #MQ2460G 24” x 60” shelves  
   (08) #MQ74UPE 74” posts  
   (08) #5PCBX 5” swivel casters with brakes

Item #9  Pot and Pan Storage: One (1) Lot Required  
A. InterMetro Industries MetroMax Q posts and shelves to consist of:  
   (04) #MQ2436G 24” x 36” shelves  
   (04) #MQ2442G 24” x 42” shelves  
   (16) #MQ2460G 24” x 60” shelves  
   (24) #MQ74UPE 74” posts  
   (24) #5PCBX 5” swivel caster with brakes
Item #10  Security Shelving: Two (2) Required
A.  New Age Industrial Aluminum Security Fence
   1.  Security fence to be constructed with 2" x 2", 10 ga. aluminum post with adjustable
       flanged feet at top and bottom per size and shape on floorplan
   2.  Fencing to be constructed of 1-1/2" x 1-3/4" 13 ga. tubular frame with 1-1/4" x 2-1/4" T-Bar
       aluminum horizontal fencing
   3.  Furnish opening with sliding door with a minimum of a 48" opening to allow pallets to be
       placed into fenced area. Door to have locking hardware

Item #11  Floor Trough: By Plumbing Contractor

Item #12  3-Compartment Sink/Clean Dishtable: One (1) Required
A.  Custom fabricated per general specifications, full st. stl. NSF
   1.  14 ga. "L" shaped counter per size and shape on floorplan with integral 8" h backsplash
       with 2" return to wall on 45 degree angle, terminate free edges in a 3"h x 1-1/2" rolled rim
   2.  Weld integral with top (3) fully coved sink compartments measuring 26-1/2" x 26-1/2" x
       14"d, fit each with lever handle drain
       a.  Furnish (2) T&S Brass B-0231-CC faucets
   3.  Mount top on open st. stl. base. At 3-compartment sink, furnish 1-1/4" st. stl. crossrails
       welded to 1-5/8" st. stl. legs at 10" aff, omit crossrails at rear for plumbing access.
       Remaining base to have 1-1/4" st. stl. crossrails welded to 1-5/8" st. stl. legs with 16 ga.
       removable undershelf where available
   4.  Furnish 16 ga. st. stl. overshelv above 3-compartment sink as shown on plan. Furnish 1-1/2"
       turn up at rear and 1-1/2" turn down all free edges, mount via 1-5/8" st. stl. tubular
       supports thru splash to bracing below
   5.  Fit unit with adjustable st. stl. bullet feet
   6.  Furnish st. stl. wall panels at this unit, extend from 1" below backsplash up 24", furnish
       with splice trim at vertical joints and horizontal cap trim at top

Item #13  Booster Heater: One (1) Required
A.  Hatco Model #C-27, 208v/3Ø
   1.  Furnish standard 27KW booster heater with st. stl. slide brackets
   2.  Furnish with #SSB st. stl. body and base

Item #14  Dishmachine: One (1) Required
A.  Hobart Model #CL44e-N-BAS, 208v/3Ø
   1.  Furnish standard right to left unit with higher than standard wash chamber
   2.  Furnish with 15kw tank heat
   3.  Furnish with short and extended vent hoods
   4.  Furnish with 16 ga. st. stl. vents, extend thru finish ceiling and provide trim ring at ceiling

Item #15  Soiled Dishtable: One (1) Required
A.  Custom fabricated per general specifications, full st. stl., NSF
   1.  14 ga. st. stl. top per size and shape on floorplan with 8"h backsplash with 2” return to wall
       on 45° angle, terminate free edges in a 3”h x 1-1/2” rolled rim
   2.  Weld integral with top (1) 22” x 22” x 5”d fully coved sink compartment with weld in collar
       as described in Item #44, punch top for pre-rinse faucet and vacuum breaker holes
   3.  Furnish st. stl. disposal control bracket
   4.  Mount top on open st. stl. base with 1-1/4” st. stl. crossrails welded to 1-5/8” st. stl. legs at
       10” aff, fit legs with adjustable st. stl. bullet feet. Omit front crossrail at Item #E37 to allow
       trash container to be store below table.
   5.  Furnish unit with st. stl. booster heater slides
   6.  On walls behind table, furnish 20 ga. st. stl. wall panels. Extend from 1” below top of
       splash up 24”  Furnish vertical splice trim and top trim. Extend st. stl. panels behind Item
       #14
**Item #16  Dishroom Shelving: One (1) Lot Required**

A. InterMetro Industries Metro Max Q posts and shelves to consist of:
   - (12) #MQ2460G 24” x 60” shelves
   - (12) #MQ74UPE 74” posts
   - (12) #5PCBX5” swivel casters w/brakes
   - (06) #MTR2460XEA drying racks (2 per unit)

**Item #17  Vector Multi-Cook Oven: One (1) Required**

A. Alto-Shaam Model #VMC-F4E, 208v/3Ø
   1. Furnish standard oven to accommodate (4) full size sheet pans
   2. Furnish with #5025510 st. stl. stand with casters
   3. Furnish with single point quick connect core temperature probe

**Item #18  Work Counter: One (1) Required**

A. Custom fabricated per general specifications, full st. stl., NSF
   1. 14 ga. st. stl. top measuring 30” x 48” with integral 4”h backsplash with 1”return to the wall on 90º angle, terminate free edges down 1-1/2” and back ½”
   2. Furnish to the far left end a tier of (3) 15” x 20” x 5”d st. stl. drawers mounted on heavy duty roller bearing slides
   3. To the right of the drawer housing, furnish a fully enclosed st. stl. base with 16 ga. st. stl. bottom and midshelf.
   4. Furnish with double pan st. stl. hinged door with recessed pull and lock
   5. On walls behind table, furnish 20 ga. st. stl. wall panels. Extend from 1” below top of splash up 24”. Furnish vertical splice trim and top trim. Extend st. stl. panels behind Item #19
   6. Furnish with 6” st. stl. legs with adjustable st. stl. bullet feet

**Item #19  Conveyor Pizza Oven: Two (2) Required**

A. Lincoln Model #2501, 208v/1Ø
   1. Furnish standard units with stacking kit
   2. Furnish each with 50” conveyor. 16” wide with st. stl. exit shelf on both units
   B. Custom fabricated stand per general specifications, full st. stl., NSF
      1. 14 ga. st. stl. stand measuring 30” x 30” x 20”h with 1-1/2” turn upon on sides and rear, terminate free edges down 1-1/2” and back ½”
      2. Mount top on open st. stl. base with 16 ga. st. stl. undershelf welded to 1-5/8” st. stl. legs at 10” aff
      3. Fit unit with heavy duty swivel casters, all with brakes

**Item #20  Pizza Cutting Table: One (1) Required**

A. Custom fabricated per general specifications, full st. stl., NSF
   1. 14 ga. st. stl. top measuring 30” x 72” with integral 4”h backsplash with 1” return to wall on a 90º angle, terminate free edges down 1-1/2” and back ½”
   2. Mount top on semi enclosed base with 16 ga. st. stl. bottom shelf, divide base into 2 compartments with st. stl. vertical mullions. Each compartment to have 2” x 2” st. stl. slides to accept Owner furnished bread racks, verify spacing with Owner prior to fabrication
   3. On walls behind table, furnish 20 ga. st. stl. wall panels. Extend from 1” below top of splash up 24”. Furnish vertical splice trim and top trim. Extend st. stl. panels behind Item #19
   4. Furnish unit with 6” st. stl. legs with adjustable st. stl. bullet feet
Item #21  Pizza Holding Cabinet: Two (2) Required
A. Carter-Hoffman Model #DF1818-S, 208v/1Ø
   1. Furnish standard doorless units with 5 pan capacity
   2. Stack unit as required

Item #22  Espresso Machine: Existing
A. Frankie Model #A600
   1. K.E.C. to relocate to Park Hill South High School from Park Hill High School
   2. Utilities to be disconnected by others

Item #23  Snack Storage Shelving: One (1) Lot Required
A. InterMetro Industries MetroMax Q posts and shelves to consist of:
   - (08) #MQ2442G 24” x 42” shelves
   - (08) #MQ2448G 24” x 48” shelves
   - (16) #MQ74UE 74” posts
   - (16) #5PCBX 5” swivel casters with brake

Item #24  Spare Number

Item #25  Adjustable Dunnage Shelving: One (1) Lot Required
A. New Age Industrial HD Series Dunnage Shelving
   - (02) #2436HD 24” x 36” units
   - (04) #2448HD 24” x 48” units
   - (12) #68P 68” posts

Item #26  Spare Number

Item #27  Snack Counter: One (1) Required
A. Custom fabricated per general specifications, full st. stl., NSF
   1. 14 ga. st. stl. top measuring 30” x 108” with integral 4”h backsplash with 1” return to wall on 90º angle, terminate free edges down 1-1/2” and back ½”
   2. Mount top on fully enclose base with st. stl. bottom and midshelf, furnish with double pan st. stl. doors with recessed pulls and locks. To far left end of counter, furnish opening to accept Item #28 drawer warmer, omit back of cabinet at this location for electrical access.
   3. Furnish with 6” st. stl. lets with adjustable st. stl. bullet feet

Item #28  Drawer Warmer: One (1) Required
A. Vulcan Model #VW3S, 120v/1Ø
   1. Furnish standard 3 drawer unit
   2. Furnish with trim kit to allow unit to be built into Item #27

Item #29  Dry Display Case: One (1) Required
A. Structural Concepts Model #HV48, 120v/1Ø
   1. Furnish standard unit non refrigerated cabinet
   2. Furnish unit with premium laminate finish, verify with Owner/Architect
   3. Furnish with black interior with full mirror end panel on right and left end
   4. Furnish unit with reflective rear glass sliding doors with locks
   5. Furnish curved lift up front glass with lock
   6. Furnish with clear glass LED lighted shelves

Item #30  Cashier Counter: One (1) Required
A. Custom fabricated per general specifications, full st. stl., NSF
   1. 14 ga. st. stl. top measuring 30” x 54” with all free edges turned down 1-1/2” and back ½”
   2. Mount top on fully enclosed st. stl. base. On student side and exposed ends furnish premium laminate finish, to be selected By Owner
   3. At POS on operators side, just below the top, furnish with 18 ga. st. stl. cash drawer with heavy duty slides, cylinder lock, and 3” deep st. stl. liner. Below the drawer, provide
double pan st. stl. hinged door with lock. Furnish 16 ga. st. stl. undershelf with grommet in undershelf to allow power and data cords to be extended to floor box below unit.
4. Remaining base to have 16 ga. st. stl. bottom shelf and midshelf with double pan st. stl. doors with locks
5. Furnish grommeted hole in top for POS power and data
6. Furnish with 6” st. stl. legs with adjustable st. stl. bullet feet
7. On student side and both ends, furnish with st. stl. kickplate. Kickplate to be fastened to base with st. stl. pan head screws.

Item #31  Grab and Go Case: One (1) Required
A. Structural Concepts Model #CO55R, 120v/1Ø
   1. Furnish standard self contained unit with premium laminate on exterior
   2. Furnish with black interior and full mirror right and left end panels
   3. Furnish with LED lighted metal shelves
   4. Furnish with solid lockable (removable) security cover
   5. Furnish with Clean Sweep coil cleaner
   6. Furnish with st. stl. louvered front panel
   7. Furnish unit with casters

Item #32  Spare Number

Item #33  Pizza Counter: One (1) Required
A. Custom fabricated per general specifications, full st. stl., NSF
   1. 14 ga. type 304 st. stl. top measuring approximately 114” x 36” with 1-1/2” turn down on all sides. Top to have #4 satin finish with all edges having #7 high-light finish. Where top abuts Item #34, units to be field welded, ground and polished.
   2. Mount top on fully enclosed 18 ga. st. stl. base with 14 ga. support framework and triangular mounting plate at each leg location.
   3. Furnish 8” wide solid surface trayslide on student side of unit. Trayslide to have wood substrate with Corian, Ash Concrete, top cap and 4” turn down on front. Exposed wood on back side to be covered with 18 ga. st. stl. flat stock Refer to trayslide detail in drawings.
   4. On operators side at the hot/cold control panel, furnish st. stl. removable panel with cut out for controls hot/cold well controls. To the right and left of this panel, provide st. stl. apron with cutouts for heatlamp controls as described below. Below apron furnish st. stl. hinged doors with louvered fronts to allow proper air flow within the base of the cabinet. Furnish doors with recessed pulls and magnetic closures. Furnish 16 ga. st. stl. undershelf at each of these locations.
   5. Furnish unit with Duke #ADI-5HC hot/cold electric drop-in or approved equal
      a. Recess drop in unit 1” from top of counter to accept full size sheet pans
      b. Unit to be operable in wet or dry application
      c. Hot/Cold wells fabricated to allow food pans to be flush with the top of the drop in unit. Units with recessed pans will not be accepted
      d. Each well to have brass shut-off valve, manifold drain to master valve and 18” drain hose. Master valve to be placed to allow wells to be easily drained into a bucket
      e. Serving line manufacturer to furnish each well to have ¾” milestone cover with 2” finger pull located toward the operator side and centered left to right. Color to be Stellar Night or Stellar Snow (Owner to Verify Color). Verify size before fabricating to allow for snug fit with minimal gaps between pieces.
   6. Furnish each well with individual controls, mount controls directly below top in st. stl. apron
   7. On operators side, furnish 7” st. stl. workboard. Divide into (2) pieces and mount on drop down brackets.
   8. Furnish unit with 6” st. stl. legs with adjustable st. stl. bullet feet
   9. Furnish unit with Duke #TS421-74 sneeze guard with 3/8” tempered glass top shelf and adjustable guard and 1” st. stl. tube posts and hardware. Furnish with quartz heater and LED lighting above, divided and wire quartz heater and LED lights into two sections to allow the operator to control heat/lights above 3 of the wells and 2 of the wells separately.
a. Furnish as an alternate price English #AMA-101A adjustable sneeze guard with brushed st. stl. finish. Furnish (2) Hatco # GRN4L-36 heat strip and LED light combo units, each unit to be controlled individually. Halogen radiant heat to be controlled by dimmer switch, with separate controls for heat strip and LED light. Install remote control for each in apron of the base cabinet. Sneez guards to be installed and pre-wired by serving line manufacturer.

10. Wire heatlamps and drop-in hot/cold unit to j-box below counter for direct wire connection by E.C.

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**Item #34**  
**Deli Counter: One (1) Required**

A. Custom fabricated per general specifications, full st. stl., NSF

1. 14 ga. type 304 st. stl. top measuring approximately 114” x 36” with 1-1/2” turn down on all sides. Top to have #4 satin finish with all edges having #7 high-light finish. Where top abuts Item #34 and Item #35, units to be field welded, ground and polished.

2. Mount top on fully enclosed 18 ga. st. stl. base with 14 ga. support framework and triangular mounting plate at each leg location.

3. Furnish 8” wide solid surface trayslide on student side of unit. Trayslide to have wood substrate with Corian, Ash Concrete, top cap and 4” turn down on front. Exposed wood on back side to be covered with 18 ga. st. stl. flat stock. Refer to trayslide detail in drawings.

4. On operators side at the hot/cold control panel, furnish st. stl. removable panel with cut outs for controls hot/cold well controls. To the right and left of this panel, provide st. stl. apron with cutouts for LED light controls as described below. Below apron furnish st. stl. hinged doors with louvered fronts to allow proper air flow within the base of the cabinet. Furnish doors with recessed pulls and magnetic closures. Furnish 16 ga. st. stl. undershelf at each of these locations.

5. Furnish unit with Duke #ADI-5HC hot/cold electric drop-in or approved equal
   a. Recess drop in unit 1” from top of counter to accept full size sheet pans
   b. Unit to be operable in wet or dry application
   c. Hot/Cold wells fabricated to allow food pans to be flush with the top of the drop in unit. Units with recessed pans will not be accepted
   d. Each well to have brass shut-off valve, manifold drain to master valve and 18” drain hose. Master valve to be placed to allow wells to be easily drained into a bucket

6. Furnish each well with individual controls, mount controls directly below top in st. stl. apron

7. On operators side, furnish 7” st. stl. workboard. Divide into (2) pieces and mount on drop down brackets.

8. Furnish unit with 6” st. stl. legs with adjustable st. stl. bullet feet

9. Furnish unit with Duke #TS421-74 sneeze guard with 3/8” tempered glass top shelf and adjustable guard and 1” st. stl. tube posts and hardware. Furnish with quartz heater and LED lighting above, divided and wire quartz heater and LED lights into two sections to allow the operator to control heat/lights above 3 of the wells and 2 of the wells separately.
   a. Furnish as an alternate price English #AMA-101A adjustable sneeze guard with brushed st. stl. finish. Furnish LED light unit, each unit to be controlled individually. Sneez guards to be installed and pre-wired by serving line manufacturer

10. Wire LED lights and drop-in hot/cold unit to j-box below counter for direct wire connection by E.C.

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**Item #35**  
**Grill Counter: One (1) Required**

A. Custom fabricated per general specifications, full st. stl., NSF

1. 14 ga. type 304 st. stl. top measuring approximately 120” x 36” with 1-1/2” turn down on all sides. Top to have #4 satin finish with all edges having #7 high-light finish. Where top abuts Item #34, units to be field welded, ground and polished.

2. Mount top on fully enclosed 18 ga. st. stl. base with 14 ga. support framework and triangular mounting plate at each leg location.
3. Furnish 8” wide solid surface trayslide on student side of unit. Trayslide to have wood substrate with Corian, Ash Concrete, top cap and 4” turn down on front. Exposed wood on back side to be covered with 18 ga. st. stl. flat stock. Refer to trayslide detail in drawings.

4. On operators side at the hot/cold control panel, furnish st. stl. removable panel with cut out for controls hot/cold well controls. To the right and left of this panel, provide st. stl. apron with cutouts for heatlamp controls as described below. Below apron furnish st. stl. hinged doors with louvered fronts to allow proper air flow within the base of the cabinet. Furnish doors with recessed pulls and magnetic closures. Furnish 16 ga. st. stl. undershelf at each of these locations.

5. To far left end of the servers side, furnish louvered doors with recessed pulls for access to the HotFrost refrigeration system described below.

6. Furnish unit with Duke #ADI-5HC hot/cold electric drop-in or approved equal
   a. Recess drop in unit 1” from top of counter to accept full size sheet pans
   b. Unit to be operable in wet or dry application
   c. Hot/Cold wells fabricated to allow food pans to be flush with the top of the drop in unit. Units with recessed pans will not be accepted
   d. Each well to have brass shut-off valve, manifold drain to master valve and 18” drain hose. Master valve to be placed to allow wells to be easily drained into a bucket

7. Furnish each well with individual controls, mount controls directly below top in st. stl. apron

8. On operators side, furnishing 7” st. stl. workboard. Divide into (2) pieces and mount on drop down brackets.

9. Furnish unit with 6” st. stl. legs with adjustable st. stl. bullet feet

10. Furnish above hot/cold wells, #HF91 two tier HotFrost merchandising shelves, top and bottom shelf to have heatlamp and LED display lighting.

Item #36  Spare Number

Item #37  Spare Number

Item #38  International Counters: Two (2) Required

A. Custom fabricated per general specifications, full st. stl., NSF
   1. 14 ga. type 304 st. stl. top measuring approximately 92” x 36” with 1-1/2” turn down on student and server sides, ends that abut walls shall have a 4”h splash with 1” return to the wall on a 90º angle. Top to have #4 satin finish with all edges having #7 high-light finish.
   2. Mount top on fully enclosed 18 ga. st. stl. base with 14 ga. support framework and triangular mounting plate at each leg location.
   3. Furnish 8” wide solid surface trayslide on student side of unit. Trayslide to have wood substrate with Corian, Ash Concrete, top cap and 4” turn down on front. Exposed wood on back side to be covered with 18 ga. st. stl. flat stock. Refer to trayslide detail in drawings.
   4. On operators side at the hot/cold control panel, furnish st. stl. removable panel with cut out for controls hot/cold well controls. To the right and left of this panel, provide st. stl. apron with cutouts for heatlamp controls as described below. Below apron furnish st. stl. hinged doors with louvered fronts to allow proper air flow within the base of the cabinet. Furnish doors with recessed pulls and magnetic closures. Furnish 16 ga. st. stl. undershelf at each of these locations.
   5. Furnish unit with Duke #ADI-5HC hot/cold electric drop-in or approved equal
      a. Recess drop in unit 1” from top of counter to accept full size sheet pans
      b. Unit to be operable in wet or dry application
      c. Hot/Cold wells fabricated to allow food pans to be flush with the top of the drop in unit. Units with recessed pans will not be accepted
      d. Each well to have brass shut-off valve, manifold drain to master valve and 18” drain hose. Master valve to be placed to allow wells to be easily drained into a bucket
      e. Serving line manufacturer to furnish a total of (5) ¾” silestone covers with 2” finger pull located toward the operator side and centered left to right. Color to be
Stellar Night or Stellar Snow (Owner to Verify Color). Verify size before fabricating to allow for snug fit with minimal gaps between pieces.

6. Furnish each well with individual controls, mount controls directly below top in st. stl. apron

7. On operators side, furnish 7" st. stl. workboard. Divide into (2) pieces and mount on drop down brackets.

8. Furnish unit with 6" st. stl. legs with adjustable st. stl. bullet feet

9. Furnish each unit with Duke #TS421-74 sneeze guard with 3/8" tempered glass top shelf and adjustable guard and 1" st. stl. tube posts and hardware. Furnish with quartz heater and LED lighting above, divided and wire quartz heater and LED lights into two sections to allow the operator to control heat/lights above 3 of the wells and 2 of the wells separately.
   a. Furnish as an alternate price English #AMA-101A adjustable sneeze guard with brushed st. stl. finish. Furnish (1) Hatco # GRN4L-30 and (1) #GRN4L-24 heat strip and LED light combo unit, each unit to be controlled individually. Halogen radiant heat to be controlled by dimmer switch, with separate controls for heat strip and LED light. Install remote control for each in apron of the base cabinet. Sneeze guards to be installed and pre-wired by serving line manufacturer.

10. Wire heatlamps and drop-in hot/cold unit to j-box below counter for direct wire connection by E.C

**Item #39 Daily Choice Counters: Two (2) Required**

A. Custom fabricated per general specifications, full st. stl., NSF

1. 14 ga. type 304 st. stl. top measuring approximately 92” x 36” with 1-1/2” turn down on student and server sides, ends that abut walls shall have a 4”h splash with 1” return to the wall on a 90º angle. Where tops join, field weld, ground and polish. Top to have #4 satin finish with all edges having #7 high-light finish.

2. Mount top on fully enclosed 18 ga. st. stl. base with 1 4 ga. support framework and triangular mounting plate at each leg location.

3. Furnish 8” wide solid surface trayslide on student side of unit. Trayslide to have wood substrate with Corian, Ash Concrete, top cap and 4” turn down on front. Exposed wood on back side to be covered with 18 ga. st. stl. flat stock. Refer to trayslide detail in drawings.

4. On operators side at the hot/cold control panel, furnish st. stl. removable panel with cut out for controls hot/cold well controls. To the right and left of this panel, provide st. stl. apron with cutouts for heatlamp controls as described below. Below apron furnish st. stl. hinged doors with louvered fronts to allow proper air flow within the base of the cabinet. Furnish doors with recessed pulls and magnetic closures. Furnish 16 ga. st. stl. undershelf at each of these locations.

5. Furnish unit with Duke #ADI-5HC hot/cold electric drop-in or approved equal
   a. Recess drop in unit 1” from top of counter to accept full size sheet pans
   b. Unit to be operable in wet or dry application
   c. Hot/Cold wells fabricated to allow food pans to be flush with the top of the drop in unit. Units with recessed pans will not be accepted
   d. Each well to have brass shut-off valve, manifold drain to master valve and 18” drain hose. Master valve to be placed to allow wells to be easily drained into a bucket

6. Furnish each well with individual controls, mount controls directly below top in st. stl. apron

7. On operators side, furnish 7” st. stl. workboard. Divide into (2) pieces and mount on drop down brackets.

8. Furnish unit with 6” st. stl. legs with adjustable st. stl. bullet feet

9. Furnish each unit with Duke #TS421-74 sneeze guard with 3/8” tempered glass top shelf and adjustable guard and 1” st. stl. tube posts and hardware. Furnish with quartz heater and LED lighting above, divided and wire quartz heater and LED lights into two sections to allow the operator to control heat/lights above 3 of the wells and 2 of the wells separately.
   a. Furnish as an alternate price English #AMA-101A adjustable sneeze guard with brushed st. stl. finish. Furnish LED light unit, each unit to be controlled individually. Sneeze guards to be installed and pre-wired by serving line manufacturer.
10. Wire heatlamps and drop-in hot/cold unit to j-box below counter for direct wire connection by E.C.

Item #40  Milk/Beverage Cooler: Six (6) Required
A. Structural Concepts Free Standing Self Service Cases
   1. Furnish (04) #CO53RM and (02) #CO63RM units. The #CO63RM units to be located at the center cashier location.
   2. Furnish unit with premium laminate top, front and sides. Color to be selected By Owner
   3. Furnish with Breeze-E w/Energy Wise refrigeration
   4. Furnish with clean Sweep coil cleaner
   5. Furnish each with solid removable locking security cover
   6. Furnish each with second year parts and labor warranty

Item #41  Cashier Counter: Three (3) Required
A. Custom fabricated per general specifications, full st. stl. NSF
   1. 14 ga. type 304 st. stl. top measuring approximately 30” x 36” with 1-1/2” turn down on all sides. Top to have #4 satin finish with all edges having #7 high-light finish. Furnish with interlock device to connect to Item #40. Furnish grommet hole in center of cashier station top, location to be determined on final approval drawings
   2. Mount top on fully enclosed 18 ga. st. stl. base with 14 ga. support framework with 14 ga. triangular mounting plate at each caster location. Unit to have premium plastic laminate on exposed surfaces, doors, and louvered panels. Laminate manufacturer and color to be selected by Owner.
   3. Furnish 8” wide solid surface trayslide on both sides of unit. Trayslide to have ¾” plywood substrate with Corian top and 1-1/2” turn down on all exposed edges. Trayslides to be mounted on heavy duty st. stl. drop down brackets at 32” aff.
   4. At operators end of unit, just below the top, furnish with 18 ga. st. stl. cash drawer with heavy duty slides, cylinder lock, and 3” deep st. stl. liner
   5. Below the drawer, provide double pan st. stl. hinged door with lock and matching plastic laminate. Furnish 16 ga. st. stl. undershelf with grommet in undershelf to allow power and data cords to be extended to floor box below unit.
   6. Furnish unit with removable st. stl. kickplate on student side and exposed ends. St. stl. kickplate to be mounted to base via st. stl. pan head screws. Kickplate must be removable for cleaning and service. Where applicable, end toe bases must be flush to end panels with adjacent units to abutt tightly.
   7. Furnish unit with 5” diameter swivel casters with mounting plate, all with brakes

Item #42  Condiment Counter: Four (4) Required
A. Custom fabricated per general specifications, full st. stl., NSF
   1. 14 ga. type 304 st. stl. top measuring 36” x 40” with all edges turned down 1-1/2” and back 1/2”. Top to have #4 satin finish with all edges having #7 high-lighted finish. Furnish with non-protruding interlock device to connect to Item #43
   1. Punch top to accept silver cylinders and pumps as described below
   2. Furnish each with (12) Tablecraft #34 st. stl. silver cylinders
   3. Furnish each with (04) Server Products #67580 st. stl. condiment pumps, recess pumps in countertop 5”
      a. Recess pumps to set in removable lift out st. stl. pan with 2” rim with hug edge
   4. Furnish 16 ga. st. stl. spice shelf above counter measuring 16” x 24”, mount via 1” st. stl. square tubing to counter below
   5. Mount top on enclosed 16 ga. st. stl. base with laminate overlay, laminate color to be selected By Owner. Along one 40” side furnish unit with double pan st. stl. hinged doors with laminate overlay and recessed pulls with locks. Furnish with 1-1/2” x 1-1/2” st. stl. corner guards with a hug edge.
   6. Furnish unit with heavy duty swivel casters, all with brakes
7. Furnish unit with removable st. stl. kickplate on student side and exposed ends. St. stl. kickplate to be mounted to base via st. stl. pan head screws. Kickplate must be removable for cleaning and service. Where applicable, end toe bases must be flush to end panels with adjacent units to abutt tightly.

Item #43  **Choice Bar: Two Required**

A. Custom fabricated per general specifications, full st. stl., NSF

2. 14 ga. type 304 st. stl. top measuring approximately 96" x 36" with 1-1/2" turn down on all sides. Top to have #4 satin finish with all edges having #7 high-light finish. Furnish with non-protruding interlock device to connect to Item #42

3. Mount top on fully enclosed 18 ga. st. stl. base with 12 ga. support framework with 12 ga. triangular mounting plate at each caster location. Unit to have premium plastic laminate on exposed surfaces, doors, and louvers. Laminate manufacturer and color to be selected by Owner.

4. Furnish 8" wide solid surface trayslide on both sides of unit. Trayslide to have 3/4" plywood substrate with Corian, Ash Concrete, top and 1-1/2" turn down on all exposed edges. Trayslides to be mounted on heavy duty st. stl. drop down brackets at 32" aff.

5. On the control side at the hot/cold control panel, furnish double pan st. stl. doors so controls are not accessible to the students. To the right and left of this panel, provide st. stl. hinged doors below with louvers to allow proper air flow within the base of the cabinet. Furnish doors with recessed pulls and magnetic closure and locks. Doors to have matching laminate. Furnish 16 ga. st. stl. bottom shelf at each of these locations. On opposite side of controls furnish st. stl. panel with laminate finish.

6. Furnish unit with Duke #ADI-5HC hot/cold electric drop-in or approved equal
   a. Unit to be operable in wet or dry application
   b. Hot/Cold wells fabricated to allow food pans to be flush with the top of the drop in unit. Units with recessed pans will not be accepted
   c. Each well to have brass shut-off valve, manifold drain to master valve and 18" drain hose. Master valve to be placed to allow wells to be easily drained into a bucket

7. Furnish each well with individual controls, mount controls directly below top in st. stl. apron

8. Furnish unit with removable st. stl. kickplate on student side and exposed ends. St. stl. kickplate to be mounted to base via st. stl. pan head screws. Kickplate must be removable for cleaning and service. Where applicable, end toe bases must be flush to end panels with adjacent units to abutt tightly.

9. Furnish unit with 5" diameter swivel casters with mounting plate, all with brakes

10. Furnish each unit with Duke #TS480-74-D sneeze guard with 3/8" tempered glass top shelf and adjustable guard and 1" st. stl. tube posts and hardware. Furnish LED lighting above.
    a. Furnish as an alternate price English #AMA-101A dual sided adjustable sneeze guard with brushed st. stl. finish. Furnish LED light unit, each unit to be controlled individually, install remote control for each in apron of the base cabinet behind doors and not accessible to the students. Sneeze guards to be installed and pre-wired by serving line manufacturer.

11. Wire LED lights and drop-in hot/cold unit to j-box below counter for direct wire connection by E.C.

Item #44  **Disposal: One (1) Required**

A. Salvajor Model #200-SA-MRSS, 208v/3Ø

1. Furnish standard 2hp unit

2. Furnish unit with 6-1/2" weld in collar

3. Furnish unit with #MRSS control

4. Furnish with T&S Brass Model #B-0113-B prerinse faucet

Item #45  **Refrigerated Grab and Go Case: One (1) Required**
A. Structural Concepts Model #CO65R, 208v/1Ø
   1. Furnish standard self contained unit with premium laminate on exterior
   2. Furnish with black interior and full mirror right and left end panels
   3. Furnish with rear loading hinged doors with locks
   4. Furnish with LED lighted metal shelves
   5. Furnish with solid lockable (removable) security cover
   6. Furnish with Clean Sweep coil cleaner
   7. Furnish unit with casters

Item #46 Ice Cream Freezer: One (1) Required
A. Master-Bilt Model #MSC-31AN
   1. Furnish standard curved lid display freezer with locking lid

Item #47 St. Stl. Trim: One (1) Lot Required
A. Custom fabricated per general specifications, full st. stl., NSF
   1. At the end wall, running vertically, furnish “U” shaped st. stl. cap trim measuring approximately 4” x 8” x 4” with a hug edge on the 4” sides to minimize the gap between Item #E24 and #E25
   2. Furnish matching piece, running horizontally below existing header to minimize opening into the kitchen space

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Part I. PRODUCTS

1.01 MANUFACTURERS

a. Provide products of manufacturers as named in individual articles.
b. Where no manufacturer is specified, provide products of manufacturers in compliance with requirements.
c. PHSD is certified to maintain the warranty of Belden products. PHSD allows for equal products from manufacturers other than Belden. However, if a vendor chooses to use another manufacturer, the vendor must propose that solution as part of their bid response. The manufacturer proposed by the vendor must provide PHSD an end-to-end warranty that is equal to or greater than that of Belden as determined by PHSD. Also, PHSD shall be allowed to maintain that manufacturers product for the life of the product. Said evaluation of manufacturer will affect the bid evaluation.

1.02 FABRICATION

a. Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of equipment and its installation.
b. All fabricated equipment shall be pre-approved by PHSD.

1.03 SUITABILITY

a. Provide products that are suitable for intended use, including, but not limited to environmental, regulatory, and electrical.

1.04 VOICE/DATA TELECOMMUNICATIONS SERVICE BACKBONE CABLE

a. Copper
   1. For Telecommunications Rooms
      a) Solid copper, CMP, 24 AWG, 25 Pair, 100Ω balanced twisted-pair (UTP) backbone cable, with mechanical and transmission performance specifications that meet or exceed ANSI/TIA/EIA-568-B.2
      b) Cable shall be Belden IBDN25P, 25 pair, Category 5e, Nonbonded-Pair Cable 24 AWG solid bare copper conductors, FEP insulation, twisted pairs, rip cord, FEP jacket, or approved equal.
   2. For Ceiling Mounted Zone Enclosures
      a) Solid copper, CMP, 24 AWG, 4 Pair, 100Ω balanced twisted-pair (UTP) cable, with mechanical and transmission performance specifications that meet or exceed ANSI/TIA/EIA-568-B.2
      b) Cable shall be Belden 1213 008U1000, 4 pair, Category 5e, Nonbonded-Pair Cable 24 AWG solid bare copper conductors, FEP insulation, twisted pairs, rip cord, FEP jacket, Gray or approved equal
   b. Fiber
      1. An 850 nm laser-optimized Multimode 50/125 μm OM-4 diameter tight-buffered OFNP optical fiber capable of supporting 10 Gb/s serial transmission up to 300m (984 feet), 12 strand, with mechanical and transmission performance specifications that meet or exceed ANSI/TIA/EIA-568-B.3-1
      2. Fiber Backbone cable shall be installed in Plenum Innerduct (See section 1.31 Innerduct)
      3. Cable shall be Belden B9E048 12 strand, 50/125/900 Micron, OFNP.
   c. Where cables are routed using conduits, the backbone and horizontal cables shall be installed in separate conduits.
   d. All backbone cables shall be securely fastened to a wall and/or ladder rack of the TR served
1.05 DATA HORIZONTAL CABLE (COPPER) (CAT6A)

a. Solid copper, 23 AWG, 100Ω balanced twisted-pair (UTP), CMP, Blue, Category 6a cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA/EIA-568-C.2 up to 625 MHz for a 4-connector, 100 m (328 ft) channel.

b. Cable shall be Belden 10GX533, 4 pair, Category 6a, bonded-Pair Cable 23 AWG solid bare copper conductors, FEP insulation, twisted pairs, rip cord, FEP jacket

1.06 ACCESS CONTROL DISTRIBUTION CABLE

a. Cable shall be a composite CMP access control cable with overall jacket made up of the following:
   1. 22 AWG, 3 Pair, shielded twisted-pair (STP) [Card Reader]
   2. 22 AWG, 2 Conductor [Door Contact]
   3. 22 AWG, 4 Conductor [REX]
   4. 18 AWG, 4 Conductor [Lock/Power]

b. Cable shall be Belden 658AFJ or approved equal.

c. Cable shall have 10 LF coiled overage on each end at designated locations

d. Cable shall be run and supported to same specifications as other data cables

e. Cable shall be kept in separate bundles from other backbone and horizontal data cabling. Cable may share bundles with other access control cable.

f. Interconnections and terminations are to be handled by others

1.07 ACCESS CONTROL DOOR STATUS CABLE

a. Cable shall be run to any exterior door not designated to have an Access Control Distribution Cable

b. Stranded, 18 AWG, 4 Conductor, CMP Access control cable

c. Cable shall be Belden 6302UE or approved equal.

d. Cable shall have 10 LF coiled overage on each end at designated locations

e. Cable shall be run and supported to same specifications as other data cables

f. Cable shall be kept in separate bundles from other backbone and horizontal data cabling. Cable may share bundles with other access control cable.

g. Interconnections and terminations are to be handled by others

1.08 AUDIO VISUAL CABLE

a. Each Audio Visual cable shall consist of one (1) Cat5e patch cable of a determined length from HDBaseT transmitter to HDBaseT receiver.

b. Cable shall be Belden 1213F CAT5e+ (350MHz), 4-Pair, F/UTP-foil shielded, Plenum-CMP, Premise Horizontal cable, 24 AWG solid bare copper conductors, FEP insulation, overall Beldfoil® shield, Flamarrest® jacket, RJ-45 compatible

c. Cables shall be terminated on each end with shielded 8P8C Modular plug installed per manufacturers specifications.

d. Entire cable assembly shall meet the requirements found in the TIA/EIA-568-C series of standards.

e. At a minimum, cables shall exceed the key performance parameters for Cat 5e found in TIA/EIA-568-C.2. The balanced twisted-pair cabling system shall also meet all the requirements of ISO/IEC 11801:2002 Ed. 2 / Amendment 2.

f. All balanced twisted-pair cable links shall be tested for basic continuity, length, Insertion Loss, Return Loss, NEXT, PSNEXT and PSACRF. These tests are performed using an automated tester.

g. Each pair in every installed cabling run shall be tested using a test set that detects and identifies opens, shorts, polarity and pair reversals, crossed pairs, and split pairs. The results shall be recorded as Pass/Fail (as indicated by the test set) and referenced to the appropriate cable identification number (see Figure 7: Jack Labeling example). Any fault shall be corrected and the run re-tested prior to final acceptance.
h. Every data horizontal cable run shall be tested for installed length using a time domain reflectometer (TDR) device. The cable length shall not exceed 90 m (295 ft). The cable length shall be recorded, referencing the cable identification number and circuit/pair number.

i. Reference the table below for approved RJ45 Modular Plugs:

<table>
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<tr>
<th>Component</th>
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<td>Monoprice</td>
<td>7301</td>
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<td>RJ45 Modular Plug</td>
<td>Monoprice</td>
<td>24758</td>
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<td>Stewart Connector</td>
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<td>RJ45 Modular Plug</td>
<td>Stewart Connector</td>
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j. Audio Visual cables shall be installed and supported in the same manner as all data cabling.

1.09 Data Work Area Outlet

a. A Data Work Area Outlet shall consist of a Data Faceplate with a specified number of Modular Data Jacks.

b. A minimum of 9’ of service loop shall be cleanly and securely installed directly above outlet in accessible ceiling.

c. The Data Faceplate shall be installed and labeled as shown in the figure below.

![Data Work Area Outlet Installation Example](image)

1.10 In-Ceiling Data Outlet

a. An In-Ceiling Data Outlet shall consist of one (1) Data Surface Mount Box with one (1) or more Modular Data Jack.

b. Vendor shall leave at least fifteen (15) feet of slack coiled and secured above surface mount box for future location adjustment.

c. Box shall be mounted to structural steel except where structure is higher than 3’ above ceiling. Where structure is higher than 3’ above ceiling box must be attached to nearest grid wire with Erico 4Z34 or similar hanger. Boxes must not be attached to any HVAC or other equipment.

d. Location shall be labeled on both surface mount box and on nearest available grid T-Bar surface with text of at least ½” height.
1.11 **Audio-Visual Outlet**

a. An Audio-Visual Outlet shall consist of a complete interconnected solution connecting the wall plate to the display.

1. **Wall Plate:** The wall plate shall consist of a specified number of Modular Data Jacks installed in appropriately sized KeyConnect Decora Adapter – white, (1) Atlona HDVS-210H-TX HDBaseT Transmitter plate and (1) stainless steel double decora cover.

2. **Cable:** (1) Audio Visual Cable (installed connecting Audio-Visual wall plate to associated display location) and specified number of Data Horizontal Cable (Copper)

3. **Display Connection:** (1) Atlona HDVS-150-RX HDBaseT Scaler with HDMI and Analog Audio Outputs (installed at display), (1) C2G 56783 6ft High Speed HDMI® Cable (connecting HDVS-150-RX to display), and (1) Major Custom Cable 3.5SAMB-6F 3 pole 3.5 mm plug with 6’ cord or approved equal.

b. Securely anchor Atlona HDVS-150-RX HDBaseT Scaler with HDMI and Analog Audio Outputs to bridge/back box above the projector.

c. Major Custom Cable 3.5SAMB-6F (or approved equal) shall be wired to phoenix blocks on Atlona HDVS-150-RX as shown in the image below.

   ![HDVS-150-RX Wiring Detail](image)

   **FIGURE 3: HDVS-150-RX WIRING DETAIL**

d. Audio-Visual Outlets shall be fully interconnected with other components including the Audio-Visual Cable to provide a complete and usable solution.

e. The Atlona HDVS-210H-TX HDBaseT Transmitter plate shall be installed with white trim (provided in kit).
f. Reference the table below for approved stainless steel double decora cover.

<table>
<thead>
<tr>
<th>Brand</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leviton</td>
<td>84409-40</td>
</tr>
<tr>
<td>Hubbell</td>
<td>SS262L</td>
</tr>
<tr>
<td>Hellermann Tyton</td>
<td>SL262CC5</td>
</tr>
<tr>
<td>Cooper</td>
<td>93402</td>
</tr>
</tbody>
</table>

1.12 AUDIO-VISUAL FLOOR OUTLET (EXISTING)

a. An Audio-Visual Floor Outlet shall consist of one (1) Audio-Visual Outlet and specified number of Modular Data Jacks installed in appropriately sized KeyConnect Decora Adapter - White.
b. The vendor is responsible for determining, providing and installing all accessories recommended and required by the floor box manufacturer for a complete solution.
c. A minimum of 9’ of service loop shall be cleanly and securely installed directly above outlet in accessible ceiling.
d. Audio-Visual Outlets shall be fully interconnected with other components including the Audio-Visual Cable to provide a complete and usable solution.

1.13 DATA POKE-THROUGH FLOOR OUTLET

a. A Data Poke-Through Floor Outlet shall consist of one (1) Fire-Rated Poke-Through with specified number of Modular Data Jacks installed in appropriate sized KeyConnect Decora Adapter - White. Other Decora opening shall remain unused for electrical provisions for others.
b. The vendor is responsible for determining, providing and installing all accessories recommended and required by the floor box manufacturer for a complete solution.
c. A minimum of 9’ of service loop shall be cleanly and securely installed directly below outlet in accessible ceiling.
1.14 ALARM OUTLET

a. An Alarm Outlet shall consist of one (1) Data Surface Mount Box with one (1) Modular Data Jack installed in an existing Alarm control enclosure.

b. Vendor shall leave at least nine (9) feet of slack coiled and secured above ceiling for future location adjustment.

c. Location shall be labeled on both surface mount box and on the door of the enclosure with text of at least \( \frac{3}{4} \)" height.

FIGURE 5: ALARM OUTLET ENCLOSURE LABELING EXAMPLE

1.15 HVAC OUTLET

a. An HVAC Outlet shall consist of one (1) Data Surface Mount Box with one (1) Modular Data Jack.

b. Vendor shall leave at least nine (9) feet of slack coiled and secured above ceiling for future location adjustment.

c. Location shall be labeled on both surface mount box and on the door of the enclosure with text of at least \( \frac{3}{4} \)" height.

1.16 INTERCOM OUTLET

a. An Intercom Outlet shall consist of one (1) Data Surface Mount Box with one (1) Modular Data Jack.

b. Vendor shall leave at least nine (9) feet of slack coiled and secured above ceiling for future location adjustment.

1.17 WALL PHONE OUTLET

a. A Data Work Area Outlet shall consist of a Data Faceplate wall telephone mounting lugs and one (1) Modular Data Jack.

b. Faceplate shall be Belden AX102005 1-Port Stainless Steel Single Gang Keystone Faceplate with Phone Studs or approved equal.

1.18 TELEVISION OUTLET

a. A Television Outlet shall consist of one (1) Data Surface Mount Box with one (1) Modular Data Jack.

b. Surface Mount Box and Modular Data Jack shall be installed in accordance with regular In-Ceiling Data Outlet.

c. A minimum of 15’ of service loop shall be cleanly and securely installed directly above outlet in accessible ceiling.

1.19 DIGITAL SIGNAGE OUTLET

a. A Digital Signage Outlet shall consist of one (1) Data Surface Mount Box with one (1) Modular Data Jack.
b. Surface Mount Box and Modular Data Jack shall be installed in accordance with regular In-Ceiling Data Outlet.
c. A minimum of 15’ of service loop shall be cleanly and securely installed directly above outlet in accessible ceiling.

1.20 MODULAR DATA JACKS

a. Modular Data Jacks shall be 8-pin modular, category 6a, keystone, pinned T568b.
b. Modular Data Jacks on the station end shall be Belden RVAMJKUBL-S1 REVConnect 10GX UTP Modular Jack, Blue
c. Modular Data Jacks in patch panels shall be Belden RVAMJKUBK-S1 REVConnect 10GX UTP Modular Jack, Black

1.21 DATA FACEPLATES

a. Unless otherwise specified, faceplates shall be stainless steel, flush mount plate, without designation windows.
b. The use of Keystone Blanks is not permitted unless otherwise specified
c. The use of adapting plates to change from 2-gang to 1-gang boxes is not permitted.
d. Please reference the table below for approved faceplate models:

<table>
<thead>
<tr>
<th>Ports</th>
<th>Gang</th>
<th>Belden</th>
<th>Hellermann Tyton</th>
<th>Leviton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>AX102006</td>
<td>FPSINGLE-SS</td>
<td>43080-1S1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>AX102007</td>
<td>FPDUAL-SS</td>
<td>43080-1S2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>--</td>
<td>FPTRIPLE-SS</td>
<td>43080-1S3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>AX102009</td>
<td>FPQUAD-SS</td>
<td>43080-1S4</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>AX102010</td>
<td>FPSIX-SS</td>
<td>43080-1S6</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>43080-2S2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>AX102011</td>
<td>FPDGQUAD-SS</td>
<td>43080-2S4</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>AX102012</td>
<td>FBDBSIX-SS</td>
<td>43080-2S6</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>--</td>
<td>--</td>
<td>43080-2S8</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>AX102013</td>
<td>FPDG12-SS</td>
<td>43080-5S2</td>
</tr>
</tbody>
</table>

1.22 BLANK FACEPLATES

a. Unless otherwise specified, faceplates shall be stainless steel, flush, box mount plate with no holes or markings.
b. Acceptable models are as follows
   1. Hellermann Tyton FPBLANK-SS
   2. Leviton 84014-40 or 84025-40
   3. Approved alternate

1.23 DATA SURFACE MOUNT BOXES

a. Data Surface Mount Boxes shall be a side entry box with shutter door, capable of accepting 1, 2 or 4 keystone jacks.
b. Acceptable products are as follows.

<table>
<thead>
<tr>
<th>Ports</th>
<th>Elec White</th>
<th>Almond</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AX102651</td>
<td>AX104132</td>
</tr>
<tr>
<td>2</td>
<td>AX102652</td>
<td>AX104133</td>
</tr>
<tr>
<td>4</td>
<td>AX102653</td>
<td>AX104134</td>
</tr>
</tbody>
</table>

c. Boxes shall be installed with a mechanical fastener. The use of tape, hook & loop or chemical fasteners will not be allowed.
1.24 FIRE-RATED POKE-THROUGH

a. Fire-Rated Poke-Throughs shall be Hubbell SystemOne S1PTAL FRPT 4” Diameter – One Piece Unit

b. Fire-Rated Poke-Throughs shall be installed per manufacturer’s requirements using required manufacturer’s components in order to maintain all fire ratings.

c. Where electrical work is required, this shall be completed by others outside of this project.

1.25 COPPER BACKBONE & VOICE TERMINATION PANELS

a. For Main Telecommunications Rooms (TR-01)
   1. 19 in. rack mountable 110 style termination block(s) meeting Category 5e performance standards and pinned to T568b standard.
   2. For sites with four (4) or less total Telecommunications Rooms, Panel shall be Siemon S110DB2-100RWM 100-pair 19 inch panel with cable managers and covers, 2 RU, with 4-pair connecting blocks.
   3. For sites with more than four (4) total Telecommunications Rooms, Panel shall be Siemon S110DB2-200RFT 100-pair 19 inch panel with cable managers and covers, 2 RU, with 4-pair connecting blocks.
   4. Panel shall be labeled using white label tape on Siemon S110-HLDR label holders
   5. Vendor shall terminate backbone cables in numerical order of Telecommunication Room beginning on pair 26.
   6. Panels are to be installed in designated location in two-post rack.

b. For Other Telecommunications Rooms (TR-02+)
   1. 19 in. rack mountable 110 style termination block(s) meeting Category 5e performance standards and pinned to T568b standard.
   2. Panel shall be Siemon S110DB2-100RWM 100-pair 19 inch panel with cable managers and covers, 2 RU, with 4-pair connecting blocks.
   3. Panel shall be labeled using white label tape on Siemon S110-HLDR label holders
   4. Vendor shall terminate backbone cables on pairs 1-25.
   5. Panels are to be installed in designated location in two-post rack.

c. For Ceiling Mounted Zone Enclosures
   1. Belden RV5MJKUAL-S1 Cat5e Modular Jack, Keystone, Almond
   2. Modular Jack shall be installed in KeyConnect Patch Panel immediately adjacent to Fiber Optic Backbone Terminations
   3. Panels are to be installed in designated location in Ceiling Mounted Zone Enclosures

1.26 PATCH PANELS

a. Patch Panels shall be Belden AX103114 KeyConnect Patch Panel, 24-port, 1U, Black (Empty) with Modular Data Jacks (Black) to entirely fill panel.

b. The rear cable management for the patch panel shall be integrated in the design of the panel and require no additional accessories to mount in the rack.

c. Panels are to be installed in designated location on two-post rack.

d. At project completion there shall be a minimum of 10% spare space in patch panel space populated Modular Data Jacks per telecommunication room for future growth

e. Spare Modular Data Jacks shall be installed into patch panels. Patch panels shall not have empty openings or blanking modules.

f. Spare “Universal wire managers” for unused modular jacks shall be provided to PHSD in a zip-top bag and secured in vertical wire manager near patch panel for each TR

1.27 Rack Mounted Optical Fiber Termination Panel

a. For Main Telecommunications Rooms (TR-01)
1. PHSD will provide and install one (1) Optical Fiber Termination Panel in Main Telecommunications Room.
2. The vendor shall provide and install one (1) coupler plate for each other Telecommunication Room or Zone Enclosure in provided Optical Fiber Termination Panel.
3. Coupler plate shall be Leviton 5F100-2QL or approved alternate.
4. PHSD Provided Rack Mounted Optical Fiber Termination Panels may include existing fiber to other areas or other sites. The vendor will be held responsible for any damage done to existing fibers during their work.

b. For Other Telecommunications Rooms (TR-02+)
1. The Vendor shall provide and install one (1) 2U Fiber Enclosure with (1) 6-pack duplex LC coupler plate (aqua housing color), no locking feature, w/cable clamp kit, and mounting brackets for 19" rack in all other Telecommunications Rooms
2. Panel shall be Leviton 5R2UH-S06 or approved equal.
3. Coupler plate shall be Leviton 5F100-2QL or approved equal.
4. Clamp kit shall be Leviton 5RCMP-KIT or approved equal.

c. For Zone Enclosures
1. Belden AX104939 LC Duplex – OM3, Keystone, Black
2. Keystone Jacks shall be installed in KeyConnect Patch Panel immediately adjacent to Copper Backbone Terminations
3. Panels are to be installed in designated location in Ceiling Mounted Zone Enclosures

1.28 OPTICAL FIBER TERMINATIONS

a. 50/125μm Laser Optimized OM-3 Multimode fiber shall be terminated with fusion-spliced, field-installable LC connectors, which meet or exceed the performance specifications in ANSI/TIA/EIA-568-C.3. Connector shall be AFL FUSEConnect FUSE-LC9M50L-6 or approved equal.
b. Fusion spliced pigtails will not be allowed

1.29 FIRESTOPPING

a. A firestop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
b. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped using a solution approved by PHSD and AHJ.
c. Firestop systems shall be UL Classified to ASTM E814 (UL 1479).
d. Products may be in the form of pillow, foam, caulking, putty, strip, sheet, or devices that shall be specifically designed to fill holes, spaces, and voids (hereinafter referenced as cavities) at communications penetrations.
e. Firestopping materials shall also provide adhesion to substrates and maintain fire and smoke seal under normal expected movements of substrates, conduits, and cables.
f. Contractor shall take a digital time/date stamped picture of all firestops to verify completion. Contractor shall retain all images until project completion.
g. Penetrations through floor and fire-rated walls shall be firestopped after installation and testing, utilizing a firestopping assembly approved for that application.
1.30 CABLE PATHWAYS & SUPPORT

a. Cable tray through main distribution areas and branch cable management shall be provided where needed by the vendor.

b. Vertical cable runs shall be supported by cable ladder, or any other method that provides adequate support for the weight of the cable.

c. Cable raceways shall not be filled greater than the TIA/EIA-569-B recommended maximum fill for the particular raceway type, or 40%.

d. Horizontal cables shall be bundled in groups of no more than 48 cables.

e. Cable shall be installed above fire-sprinkler systems and shall not be attached to such systems or any associated ancillary equipment or hardware. The cabling system and its associated pathways shall be installed so that they do not obscure any valves, fire alarm conduit(s), boxes, or other control devices.

f. Horizontal cables shall be supported at every 1.2 m to 1.5 m (48 in to 60 in) intervals. It is recommended that the support surface is rounded without any sharp edges and at least 2 inches wide. At no point shall cable(s) rest on acoustic ceiling grids or panels.

g. Where any cable is not within a finished wall or ceiling, it must be installed in EMT conduit, unless otherwise noted.
   1. Minimum conduit size shall be 1”
   2. Boxes shall be metallic 8x8x4 hinged cover with a NEMA type 1 rating. Hoffman A8N84 or approved equivalent.

h. Where conduit, sleeves, or stubs are required, but not provided, the vendor must supply. Route and placement to be approved by PHSD prior to installation.

i. Cables shall not pass through roof or floor corrugations.

j. Cables shall be supported by appropriate support hardware. In no circumstance shall cables be supported by structural steel, HVAC equipment or any other non-approved item.

k. J-Hooks
   1. J-Hooks may be supported to any building structure within 3’ above drop tile ceilings.
   2. J-Hooks may not be suspended or supported by ceiling or ceiling wires.
   3. The following table shows recommended models of cable management to be used. All other systems must be approved by submittal before use.

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Cat6a Max Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erico CAT16HP†</td>
<td>1” J-hook</td>
<td>4</td>
</tr>
<tr>
<td>Erico CAT32HP†</td>
<td>2” J-hook</td>
<td>20</td>
</tr>
<tr>
<td>Erico CAT48HP†</td>
<td>3” J-hook</td>
<td>24</td>
</tr>
<tr>
<td>Erico CAT64HP†</td>
<td>4” J-hook</td>
<td>24</td>
</tr>
</tbody>
</table>
†or approved alternate

l. Cable Tray
   1. Cable tray shall be provided and installed as drawn on drawing set. Cable tray is designed to typically support the main trunks of horizontal distribution within buildings.
   2. The following table shows recommended cable tray to be used and max fill.
### TABLE 6: CABLE TRAY CAPACITY

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Cat6a Max Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper B-Line Flextray FTU2X6†</td>
<td>2” Deep x 6” Wide Cable Tray</td>
<td>40</td>
</tr>
<tr>
<td>Cooper B-Line Flextray FTU2X12†</td>
<td>2” Deep x 12” Wide Cable Tray</td>
<td>80</td>
</tr>
<tr>
<td>Cooper B-Line Flextray FTU2X24‡‡</td>
<td>2” Deep x 24” Wide Cable Tray</td>
<td>150</td>
</tr>
<tr>
<td>Cooper B-Line Flextray FTU4X6‡</td>
<td>4” Deep x 6” Wide Cable Tray</td>
<td>80</td>
</tr>
<tr>
<td>Cooper B-Line Flextray FTU4X12†</td>
<td>4” Deep x 12” Wide Cable Tray</td>
<td>150</td>
</tr>
<tr>
<td>Cooper B-Line Flextray FTU4X16‡</td>
<td>4” Deep x 16” Wide Cable Tray</td>
<td>250</td>
</tr>
<tr>
<td>Cooper B-Line Flextray FTU4X24‡</td>
<td>4” Deep x 24” Wide Cable Tray</td>
<td>350</td>
</tr>
</tbody>
</table>

†or approved alternate
‡May be used only with prior approval from PHSD

3. Vendor may elect to add additional tray for ease of cabling installation, but all changes must be approved by PHSD prior to installation.

4. Installation of cable tray shall meet manufacturer’s recommendations of installation at a minimum.

5. All cuts in tray shall be made at an intersection without any sharp edges exposed.

6. All sections of cable tray must be butted together parallel and secured by using a mechanical fastener (specifically designed for that purpose) or welded joint.

7. Cable tray shall be supported at a minimum of two hangers per individual 10-foot section of basket.

8. All trays shall be supported by two individual hangers (trapeze) or wall mounted. No cable tray may be center hung.

9. If cable tray is supported using threaded rod the rod must be filed down smooth with no sharp edges or ends that could cause injury while preforming future service.

10. All horizontal and vertical angle transitions shall be sweeping to account for the narrowest angle of supported bend radius with entire tray filled.
11. Chosen route to be installed as straight as possible using sweeping transitions where they are required.
12. PHSD shall approve final route and elevation once a route has been determined.
13. Cables shall not exit through any hole in tray. Cables must exit over the edge of the tray and be secured as they exit.

1.31 INNERDUCT

a. Provide a 1” plenum rated flexible communication raceway for fiber optic backbone cabling.
b. Provide all fittings to form a complete integrated raceway system per manufacturers recommendations
c. Innerduct shall be supported at a minimum of every 4 feet.
d. Provide one (1) pull box for every 360° of bend or after 200 lf of duct.
e. Pull Boxes shall be a Floresent Orange Painted, NEMA Type 1, Screw-Cover, 16”x16”x4”, box securely mounted to underside of cable tray or other support structure.
f. Only 1 splice per 100’ of innerduct is permitted. Splice shall be either mechanical or chemical and be approved by PHSD prior to use.
g. Innerduct shall be Carlon CF4X1C-XX (where XX is length on spool) or approved equal
h. Innerduct may not be installed within Cable Tray, however it may be affixed to the side or the bottom.
i. Orange painted EMT is a suitable alternate to Innerduct if vendor prefers.

1.32 SURFACE RACEWAY

a. Data Only
1. Surface raceway is only allowed on masonry walls where a flush installation is not practical. (Unless otherwise specified)
2. Surface raceway is not allowed on wood or metal framed walls, or where appropriately sized data stubs are available, unless otherwise specified.
3. Raceway base shall be Wiremold V2400B-10 secured to the wall with masonry screw or other approved fastener.
4. Raceway cover shall be Wiremold V2400BC.
5. Device boxes shall be Wiremold V2444-2.
6. Where multiple pieces of raceway cover are required, factory ends shall be butted without any gap. Cover Clips to cover joints are not allowed.
7. All device boxes shall be installed within 12” horizontally of power receptacle and at same vertical elevation of power receptacle. Where a receptacle is not available within 4’ of where device location is drawn, install where shown at elevation of typical device height in that particular area.
8. Where raceway intersects drop ceilings, ceiling grid angle shall be notched and raceway base and cover shall continue a minimum of 4” into ceiling.
9. The use of entrance ends is not permitted except where raceway ends into gypsum or other surface. Entrance end shall be Wiremold V2410A and a conduit shall be connected with insulating bushing and continue raceway into nearest accessible ceiling.

10. The use of elbows or tees is not permitted without explicit permission of PHSD. Where required, appropriate Wiremold part shall be used.

11. All raceway shall be cleanly cut and de-burred. If raceway is bent or damaged it must be discarded with the exception of minor paint damage.

12. Minor paint damage shall be touched up with Wiremold IWE-P Touch-Up Paint Pen or IWE-S Spray Paint.

b. Data + Power

1. Where specifically specified for Data + Power Provisions in the same raceway, Wiremold ALDS4000 raceway components shall be used.

2. A shop drawing shall be provided to and approved by PHSD showing specific components to be used prior to installation.

1.33 WALL PENETRATIONS (SLEEVES)

a. All low-voltage cabling that pass through a wall shall be inside an approved sleeve.

b. Sleeves shall be comprised of appropriately sized EMT with push on bushing in accessible ceiling protruding wall by a minimum of 3” on both sizes.

c. Sleeves shall be no smaller than 2” EMT and no larger than 4” EMT.

<table>
<thead>
<tr>
<th>TABLE 7: EMT SLEEVE MAXIMUM CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>2” EMT</td>
</tr>
<tr>
<td>3” EMT</td>
</tr>
<tr>
<td>4” EMT</td>
</tr>
</tbody>
</table>

d. Sleeves shall be installed in tight fitting hole and secured with appropriate fire-rated caulking.

e. Where cable trays are designed to pass through a wall, an appropriate sheet metal pan protruding at least 2” on both sides of wall shall be provided and installed. Product may either be shop built or manufacturer provided, however shop drawings or a submittal must be approved by PHSD and AHJ before installation begins.

f. All wall penetrations shall comply with local AHJ to maintain designed fire rating of wall.

1.34 FLOOR/CEILING PENETRATIONS (SLEEVES)

a. All low-voltage cabling that passes through a wall, floor or ceiling shall be inside an approved sleeve.

b. Sleeves shall be comprised of appropriately sized EMT with push on bushing protruding from the floor by a minimum of 3” on both sides.

c. Sleeves shall be no smaller than 2” EMT and no larger than 4” EMT.

<table>
<thead>
<tr>
<th>TABLE 8: EMT SLEEVE MAXIMUM CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>2” EMT</td>
</tr>
<tr>
<td>3” EMT</td>
</tr>
<tr>
<td>4” EMT</td>
</tr>
</tbody>
</table>

d. Sleeves shall be installed in tight fitting hole and secured with appropriate fire-rated caulking.

e. All floor penetrations shall comply with local AHJ to maintain designed fire rating of floor/ceiling.
1.35 2-POST RACKS
a. Racks shall be Chatsworth 46353-703 Black 3” Channel 45U 7’ Tall 19” Wide 2 Post Universal Rack

1.36 VERTICAL WIRE MANAGERS
a. Vertical wire managers shall be Chatsworth 35523-703 Evolution g2 Double-Sided Vertical Cable Managers.

1.37 HORIZONTAL WIRE MANAGERS
a. Horizontal Wire Managers shall be Chatsworth 35441-702 Evolution Horizontal Cable Managers.

1.38 LADDER RACK
a. Ladder Rack shall be provided and installed as drawn on drawing set.
b. The following table shows ladder rack to be used and max fill.

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Cat6a Max Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chatsworth 10250-712†</td>
<td>12” Wide Ladder Rack</td>
<td>240</td>
</tr>
<tr>
<td>Chatsworth 10250-718†</td>
<td>18” Wide Ladder Rack</td>
<td>432</td>
</tr>
<tr>
<td>Chatsworth 10250-724†</td>
<td>24” Wide Ladder Rack</td>
<td>720</td>
</tr>
</tbody>
</table>

†or approved alternate

c. Ladder rack must be attached to racks with appropriate black Chatsworth 3” Channel Rack-To-Runway Mounting Plate.
d. Ladder rack must be attached to walls with appropriate black Chatsworth Wall Angle Support Kit.
e. If a horizontal run requires a change in elevation, Chatsworth 10487-701 Butt-Swivel Splice Kits shall be used.
f. Sections of ladder rack shall be joined with Chatsworth 11301-701 Butt-Splice Kits.
g. Where a 90° junction is required, Chatsworth Junction-Splice Kits shall be used.
h. If ladder rack needs to be mounted vertically to a wall, Chatsworth 10608-701 Vertical Wall Brackets shall be used.
i. If ladder rack is otherwise unsupported for 5 or more feet, Chatsworth 11408-001 shall be used along with appropriately sized threaded rod.
j. If ladder rack has exposed ends, Chatsworth 10642-001 Protective End Caps shall be used.
k. All other parts and/or design must be approved by PHSD.
l. A minimum of 6” of all Ladder Racks shall be reserved for Voice/Data Telecommunications Backbone Cables and Access Control Distribution Cables. The remaining width of the Ladder rack may be used for Data Horizontal Cables.
m. Bundles of Data Horizontal Cables may be stacked in an offset arrangement no more than 2 bundles high.
n. Please reference the image below as a typical section cut of a ladder rack. The section is drafted to scale on an 18” Ladder Rack for reference purposely.
1.39 Ceiling Mounted Zone Enclosure

a. In-Ceiling Enclosure with hinged door gas-assist air cylinders; Accepts up to 2 RU of active equipment and 6 RU of standard 19” patch panels, includes mounting brackets and integrated horizontal slack manager, AC power provisions, fan assembly, air dam, and electrical junction box.

b. Ceiling Mounted Zone Enclosures shall be Panduit PZICEA PanZone® In-Ceiling Enclosure.

c. All cables entering the enclosure shall be terminated, secured and routed in such a way that the enclosure may be opened and closed without risk of cables snagging, crushing or otherwise damaged.

d. Each ceiling mounted zone enclosure shall not exceed (44) forty-four data horizontal cables without prior written approval from PHSD.

1.40 Fire Rated Plywood – Telecommunications Room Backboards

a. Plywood shall meet or exceed all codes per AHJ.

b. Plywood be a minimum of ¾” thick.

c. Fire rating stamp must be visible.

Part II. Execution

2.01 Pre-Installation Site Survey

a. Prior to start of systems installation, meet at the project site with the owner’s representative and representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the General Vendor will be necessary to plan the crucial scheduled completions of the equipment room and telecommunications closets.

b. Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.

2.02 In-Ceiling Inspection

a. Prior to ceiling tiles reinstallation, the contractor must meet at the project site with the owner’s representative and representatives of trades performing related work to verify completion of ceiling work.

b. Examine areas and conditions under which the system is to be installed. Do not proceed with the work until satisfactory conditions have been achieved.
2.03 Handling and Protection of Equipment and Materials

a. The vendor shall be responsible for safekeeping of its own and its subcontractors’ property, such as equipment and materials, on the job site. PHSD assumes no responsibility for protection of above named property against fire, theft, and environmental conditions.

2.04 Protection of Owner’s Facilities

a. The vendor shall effectively protect all PHSD facilities, equipment, and materials from dust, dirt, and damage during construction.
b. The vendor shall remove protection at completion of the work.
c. The vendor shall, at its sole cost and expense, promptly repair or replace any damage resulting from the performance of its work.

2.05 Installation

a. All work shall be performed in a good and workmanlike manner.
b. The vendor shall receive, check, unload, handle, store, and adequately protect equipment and materials to be installed as part of the contract. Materials and equipment shall be stored in areas as directed in 3.07 Delivery, Storage and Handling. Include delivery, unloading, setting in place, fastening to walls, floors, ceilings, or other structures where required, interconnecting wiring of system components, equipment alignment and adjustment, and other related work whether or not expressly defined herein.
c. All wiring above ceilings shall be installed in cable tray or open top cable hangers.
d. Do not untwist category 6A or 5E cable pairs more than 0.5 inches when terminating.
e. The contractor shall be responsible for repair and/or replacement of cables that do not pass Category 6A requirements at no additional cost to PHSD.
f. Cables shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced at no additional cost to PHSD.
g. Install cable in neat and workmanlike manner. Neatly bundle and tie all cable in closets. Leave sufficient cable for 90 degree sweeps at all vertical drops.
h. Do not install cables with more than the allowed pull force as specified in ANSI/TIA/EIA and BICSI TDDM practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on long pulls inside conduit, pulls of multiple cables into a single small bore conduit, on conduit runs greater than 100 linear feet with bends of opposing directions, and in conduit runs that exceed 180 degrees of accumulated bends. Use of tensile rated cords (i.e. fishing line) should be used for difficult or questionable pulls to judge the go/no-go condition of the conduit and pulling setup.
i. Install materials and equipment in accordance with applicable standards, codes, requirements, and recommendations of national, state, and local authorities having jurisdiction, and National Electrical Code® (NEC) 2008 and with manufacturer’s printed instructions.
j. Adhere to manufacturer’s published specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.
k. At a minimum, all installed cables shall conform to the following bending radius:
   1. Copper Horizontal Cables – 4x the diameter of the cable
   2. Copper Backbone Cables – 10x the diameter of the cable
   3. Fiber Optic Cables – 1x the diameter of the cable
l. Arrange and mount equipment and materials as described in this document, and in a manner acceptable to PHSD.
m. Install horizontal cabling to the telecommunications room (TR) as shown on drawing
n. Installation shall conform to the following basic guidelines:
   1. Use of approved wire, cable, and wiring devices
   2. Neat and uncluttered wire termination
2.06 COPPER TERMINATION HARDWARE INSTALLATION

a. Cables shall be dressed and terminated in accordance with standards-based recommendations, the manufacturer’s recommendations/installation guides, and industry best practices.

b. The twisted pairs shall be guided, positioned and secured at the connector termination point using a termination bar that locks the pairs in place to prevent untwisting of pairs into the cable when terminating the conductors.

c. The termination bar holding the wires in place at the IDC termination shall withstand a tensile force of 15 lbs minimum applied to the cable without dislodging the IDC connection.

d. Cables shall be neatly bundled, dressed, and routed to their respective termination connectors. Each patch panel shall terminate a cable bundle separated and dressed back to the point of cable entrance into the equipment cabinet or rack.

e. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-C.1 document, manufacturer’s recommendations and best industry practices.

f. Hook and loop wraps shall be used to secure bundles at least every 6” but no more than 14”.

g. Data Horizontal Cable (Copper) routing, viewed from the rear of the 2-Port Rack.
   1. Ports 1 through 12 shall be routed from the right. Ports 13 through 24 shall be routed from the left.
   2. Each cable bundle shall loop below the associated patch panel by 12 inches.
   3. See example image below for acceptable cable routing.

![FIGURE 9: ACCEPTABLE CABLE ROUTING AT PATCH PANELS](image)

2.07 TELECOMMUNICATIONS ROOM BUILDOUT

a. Racks may not be installed over carpet, if necessary remove carpet tiles or cut existing carpet around the base of the rack.

b. Racks shall be anchored to the floor with drop-in style anchors of appropriate size.

c. Vertical wire managers shall be bolted to surrounding racks.

d. For rack layout, including but not limited to patch panels and horizontal wire managers, refer to drawing set.
e. Fire rated plywood, if called out in the drawing set, shall be installed with fasteners flush to the surface, with no more than 2’ between fasteners.

f. Rack screws must be the correct diameter and thread pitch per rack manufacturer’s specification. Cross-threaded screws and/or broken screws will not be accepted.

g. Ladder rack attached to a wall shall be anchored as follows (if the wall has plywood installed, base the anchors on the substrate):
   1. Drywall – Hollow wall anchors
   2. CMU – Hollow wall anchors or sleeve anchors
   3. Concrete – Drop-in style anchors or sleeve anchors

2.08 LABELING

a. Label each faceplate with self-adhesive Permanent Polyester label with minimum 3/16 in. high characters.
   1. Use Black print on Clear tape labels for all Ivory, White, Office White, Brushed Aluminum and Stainless Steel Faceplates. Acceptable Models are as follows:
      a) Dymo Rhino 18508
      b) Dymo XTL 1868739
      c) Brother TZe121
      d) Panduit T038X000YKC-BK
   2. Use Black print on White tape labels for all others or where specifically noted.
      a) Dymo Rhino 18766
      b) Dymo XTL 1868736
      c) Brother TZe221
      d) Panduit T038X000VPC-BK

b. For any in-ceiling Data Outlets, Label each T-Grid with self-adhesive Permanent Polyester label with minimum 1/2 in. high characters.
   1. Use Black print on Clear tape labels for all Ivory, White, Office White, Brushed Aluminum and Stainless Steel surfaces. Acceptable Models are as follows:
      a) Dymo Rhino 622290
      b) Brother TZe141
   2. Use Black print on White tape labels for all others or where specifically noted.
      a) Dymo Rhino 18484
      b) Brother TZe241

c. Label each horizontal cable with permanent self-adhesive label with minimum, 1/8 in. high characters, on the cable jacket behind the patch panel and faceplate at a location that can be viewed without removing the bundle support element(s).
   1. Labels obscured from view shall not be acceptable.
   2. Use wrapping Black on White self-laminating labels. Acceptable Models are as follows:
      a) Belden AX101555
      b) Panduit S050X150YAJ
      c) Or approved alternate

d. Labels shall be machine-printed. Hand-lettered labels shall not be acceptable.

e. Labels shall be straight and completely adhered to faceplate surface.

f. Labels on faceplates shall be horizontal with horizontal text.

g. Specialty labeling applications shall be approved by PHSD.

h. Label faceplates and patch panels: TR number, followed by Patch Panel Letter, followed by Patch Panel jack number. (See Figure 10: Jack Labeling example)
2.09 TESTING

a. The test equipment shall meet the requirements found in the TIA/EIA-568-C series of standards.

b. At a minimum, all Cat6A cables shall exceed the key performance parameters for Cat 6A found in TIA/EIA-568-C.2. The balanced twisted-pair cabling system shall also meet all the requirements of ISO/IEC 11801:2002 Ed. 2 / Amendment 2.

c. All balanced twisted-pair cable links shall be tested for basic continuity, length, Insertion Loss, Return Loss, NEXT, PSNEXT and PSACRF. These tests are performed using an automated tester, such as the Fluke DSX8000.

d. In addition, a random sampling of short length and long length installed links shall be tested for PSANEXT and PSAACRF. The links selected for testing shall follow the selection criteria specified in ANSI/TIA-568-C.2 standard.

e. In regards to the sampling size for alien crosstalk testing, the CSV shall test in accordance with following requirements
   1. a minimum of 5 permanent links or 1% of installed permanent links whichever is greater, except as noted in clause ii)
   2. if 1% of installed permanent links is greater than 30, then additional testing is not required if the conditions indicated in the following table are met.

<table>
<thead>
<tr>
<th>TABLE 10: ALIEN CROSSTALK MARGIN TEST CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AXT Margin</td>
</tr>
<tr>
<td>PSANEXT</td>
</tr>
<tr>
<td>PSAACRF individual</td>
</tr>
<tr>
<td>PSAACRF average</td>
</tr>
</tbody>
</table>

f. Each pair in every installed cabling run shall be tested using a test set that detects and identifies opens, shorts, polarity and pair reversals, crossed pairs, and split pairs. The results shall be recorded as Pass/Fail (as indicated by the test set) and referenced to the appropriate cable identification number (see Figure 10: Jack Labeling example). Any fault shall be corrected and the run re-tested prior to final acceptance.

g. Every data horizontal cable run shall be tested for installed length using a time domain reflectometer (TDR) device. The cable length shall not exceed 90 m (295 ft). The cable length shall be recorded, referencing the cable identification number and circuit/pair number.

h. Category 5e and 6A performance testing shall be done according to the published standards

i. Initially test optical cable with a light source and power meter utilizing procedures as stated in ANSI/TIA/EIA-526-14A: OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant and ANSI/TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant. Measured results shall be plus/minus 1 dB of submitted loss budget calculations. If loss figures are outside this range, test cable with optical time domain reflectometer (OTDR) to determine cause of variation. Correct improper splices and replace damaged cables at no charge to the owner.
   1. Cables shall be tested at 850 and 1300 nm for multimode optical fiber cables. Cables shall be tested at 1310 and 1550 nm for singlemode optical fibers.
3. Bi-directional testing of optical fibers is required.

j. Test documentation shall be provided on permanent media within three weeks after the completion of the project. The media shall be clearly marked on the outside front cover with the words “Project Test Documentation”, the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or connector) ID, measurement direction, reference setup, and technician name(s). The test equipment name, manufacturer, model number, serial number, software version, and last calibration date will also be provided. Unless the manufacturer specifies a more frequent calibration cycle, proof of annual calibration must be documented for all test equipment used in this installation.

k. Printouts generated for each cable by the test equipment shall be submitted as part of the documentation package. Alternately, the vendor may furnish this information in electronic format on permanent media. The media shall contain the electronic equivalent of the test results as defined by the bid specification, in a file format such as Fluke (*.flw) Linkware file format or compatible with Microsoft Word or Microsoft Excel.

l. When repairs and re-tests are performed, the problem(s) found and the corrective action(s) taken shall be noted. Both the failed and passed test results shall be documented.

m. Where any portion of system does not meet the specifications, correct deviation and repeat applicable testing at no additional cost to the owner.

2.10 Removal and Replacement of Existing Ceilings

a. All work shall be completed before ceiling tiles are installed, any tiles moved are to be done at vendors own risk.

b. Carefully remove existing ceilings as required to perform the work. Restore ceiling systems to their original finish.

c. No modification and augmentation of existing suspension systems is allowed.

d. Replace damaged ceiling tiles, including tiles with holes, openings or scratches with materials of like kind.

e. All damages as seen by PHSD and General contractor are to be repaired by ceiling contractor at vendors expense.
2.11 DEMOLITION

a. All demolition labor and removal of waste required as part of this contract is the sole responsibility of the vendor.
b. All existing telecommunications stations in any room where work is being done is to be completely removed, including any station not being directly replaced as part of this project. Including, but not limited to, raceway, surface boxes, jacks, plates, station cable and backbone cable (copper & fiber). Locations that cannot be removed (in-wall) shall be blanked with an approved blank faceplate.
c. The vendor shall repair any damage caused by demolition with the exception of paint.
d. The vendor shall not cut, remove or damage any HVAC control, fire alarm, intrusion detection, RF Distribution, audio/visual (not related to this project), intercom or access control cables. If cables are damaged, they shall be repaired at the vendor’s expense.
e. For any demolition questions or concerns and clarification contact PHSD for direction.
f. The vendor is responsible for removing and disposing of any telecommunications racks, wire managers, patch panels, and associated hardware being replaced by the work in this project.
g. PHSD will remove and reinstall all electronic components including, but not limited to, switches, hubs, access points, Uninterruptable Power Supplies (UPS), Surveillance Cameras, Access Control Panels, speakers, Alarm Panels as required. Should the vendor encounter any such components that is affecting the progress of work, the vendor shall contact the construction manager immediately.
### 3.01 Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHJ</td>
<td>Authority having jurisdiction</td>
</tr>
<tr>
<td>ANEXT</td>
<td>Alien near-end crosstalk</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>AWG</td>
<td>American wire gauge</td>
</tr>
<tr>
<td>BICSI</td>
<td>Building Industry Consulting Service International</td>
</tr>
<tr>
<td>C</td>
<td>Celsius</td>
</tr>
<tr>
<td>Cat 6A</td>
<td>Augmented Category 6</td>
</tr>
<tr>
<td>CDT</td>
<td>Cable Design Technologies</td>
</tr>
<tr>
<td>CMP</td>
<td>Communications plenum</td>
</tr>
<tr>
<td>CMR</td>
<td>Communications riser</td>
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<tr>
<td>CP</td>
<td>Consolidation point</td>
</tr>
<tr>
<td>CSC</td>
<td>Construction Specifications Canada</td>
</tr>
<tr>
<td>CSI</td>
<td>The Construction Specifications Institute</td>
</tr>
<tr>
<td>CSV</td>
<td>Certified System Vendor</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel(s)</td>
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<tr>
<td>DC</td>
<td>Direct current</td>
</tr>
<tr>
<td>EF</td>
<td>Entrance facility</td>
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<tr>
<td>EIA</td>
<td>Electronic Industries Alliance</td>
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<tr>
<td>ELFEXT</td>
<td>Equal level far-end crosstalk</td>
</tr>
<tr>
<td>EMT</td>
<td>Electrical metallic tubing</td>
</tr>
<tr>
<td>ER</td>
<td>Equipment room</td>
</tr>
<tr>
<td>F</td>
<td>Fahrenheit</td>
</tr>
<tr>
<td>ft</td>
<td>Foot/feet</td>
</tr>
<tr>
<td>Gb/s</td>
<td>Gigabits per second</td>
</tr>
<tr>
<td>IBDN</td>
<td>Integrated Building Distribution Network</td>
</tr>
<tr>
<td>IDC</td>
<td>Insulation displacement contact</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
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<tr>
<td>in</td>
<td>Inch(es)</td>
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<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
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<tr>
<td>kg</td>
<td>Kilogram(s)</td>
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<tr>
<td>lb</td>
<td>Pound(s)</td>
</tr>
<tr>
<td>lbf</td>
<td>Pound-force</td>
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<tr>
<td>LC</td>
<td>Limited combustible</td>
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<tr>
<td>LF</td>
<td>Linear Foot</td>
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<tr>
<td>LSOH</td>
<td>Low smoke zero halogen</td>
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<tr>
<td>LSZH</td>
<td>Low smoke zero halogen</td>
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<td>m</td>
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<td>mm</td>
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<tr>
<td>N</td>
<td>Newton(s)</td>
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<td>NEXT</td>
<td>Near-end crosstalk</td>
</tr>
<tr>
<td>nF</td>
<td>Nanofarad(s)</td>
</tr>
<tr>
<td>ns</td>
<td>Nanosecond(s)</td>
</tr>
<tr>
<td>NVP</td>
<td>Nominal velocity of propagation</td>
</tr>
<tr>
<td>OD</td>
<td>Outside diameter</td>
</tr>
<tr>
<td>PCB</td>
<td>Printed circuit board</td>
</tr>
<tr>
<td>PE</td>
<td>Professional Engineer</td>
</tr>
<tr>
<td>pF</td>
<td>Pico farad(s)</td>
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<tr>
<td>PSACRF</td>
<td>Power-sum attenuation-to-crosstalk ratio far-end</td>
</tr>
<tr>
<td>PSAACRF</td>
<td>Power-sum attenuation-to-alien crosstalk ratio far-end</td>
</tr>
<tr>
<td>PSANEXT</td>
<td>Power-sum alien near-end crosstalk</td>
</tr>
<tr>
<td>PSELFEXT</td>
<td>Power-sum equal level far-end crosstalk</td>
</tr>
<tr>
<td>PSNEXT</td>
<td>Power-sum near-end crosstalk</td>
</tr>
<tr>
<td>RFBI</td>
<td>Request for proposal</td>
</tr>
<tr>
<td>RU</td>
<td>Rack unit [45 mm (1.75 in)]</td>
</tr>
<tr>
<td>TBB</td>
<td>Telecommunications bonding backbone</td>
</tr>
<tr>
<td>TDR</td>
<td>Time domain reflectometer</td>
</tr>
<tr>
<td>TE</td>
<td>Telecommunications enclosure</td>
</tr>
<tr>
<td>TGB</td>
<td>Telecommunications grounding busbar</td>
</tr>
<tr>
<td>TIA</td>
<td>Telecommunications Industry Association</td>
</tr>
<tr>
<td>TMGB</td>
<td>Telecommunications main grounding busbar</td>
</tr>
<tr>
<td>TO</td>
<td>Telecommunications outlet/connector</td>
</tr>
<tr>
<td>TR</td>
<td>Telecommunications room</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriters Laboratories</td>
</tr>
<tr>
<td>WA</td>
<td>Work area</td>
</tr>
</tbody>
</table>
SECTION 220500 - COMMON WORK RESULTS 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 most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   7. Grout.
   8. Plumbing demolition.
   9. Equipment installation requirements common to equipment sections.
   10. Painting and finishing.
   11. Concrete bases.
   12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.
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.”
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Coordinate layout and installation with all other trades. Refer to section 230500 ‘Common Work Results for HVAC’, paragraphs 1.3 and 1.4 for specific requirements regarding coordination procedures required.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

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 specified.

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, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

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. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Dresser Industries, Inc.; DMD Div.
      c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.
      g. Pre-approved equal.
   2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
   4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Eslon Thermoplastics.
      b. Pre-approved equal.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thompson Plastics, Inc.
      b. Pre-approved equal.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.
      b. NIBCO, Inc.; Chemtrol Div.
      c. Pre-approved equal.

E. 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: Subject to compliance with requirements, provide products by one of the following:
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: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Eclipse, Inc.
      d. Epco Sales, Inc.
      g. Zurn Industries, Inc.; Wilkins Div.
      h. Pre-approved equal.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      e. Pre-approved equal.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
      e. Pre-approved equal.

   2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Calpico, Inc.
      b. Lochinvar Corp.
      c. Pre-approved equal.

G. 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: Subject to compliance with requirements, provide products by one of the following:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.
      e. Pre-approved equal.
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: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
      e. Pre-approved equal.
   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, carbon steel, or stainless steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.
E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

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 and chrome-plated finish.
F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, 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.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. 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 Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
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. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
   1) Seal space outside of sleeve fittings with grout.
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. Refer to Division 07 Section "Joint Sealants" for materials and installation.

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.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. 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.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 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.


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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not 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 plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
   1. Construct concrete bases a minimum of 4 inches and a maximum of 6 inches deep, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 220500
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. Section Includes:
   1. Bronze angle valves.
   2. Bronze ball valves.
   5. Bronze swing check valves.
   7. Iron swing check valves with closure control.
   8. Iron, grooved-end swing check valves.
  13. Polypropylene valves.

B. Related Sections:
   1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
   2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
   3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.
C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   2. Handwheel: For valves other than quarter-turn types.
   3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
   4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
   5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Gate Valves: With rising stem.
   2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Grooved: With grooves according to AWWA C606.
   4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Nonmetallic Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. NIBCO INC.
   2. Description:
      a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. NIBCO INC.
   2. Description:
      b. CWP Rating: 400 psig.
      c. Body Design: One piece.
      d. Body Material: Bronze.
      e. Ends: Threaded.
      f. Seats: PTFE or TFE.
      g. Stem: Bronze.
      h. Ball: Chrome-plated brass.
      i. Port: Reduced.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
      d. Crane Co.; Crane Valve Group; Jenkins Valves.
      e. Crane Co.; Crane Valve Group; Stockham Division.
      f. DeZurik Water Controls.
      g. Flo Fab Inc.
      h. Hammond Valve.
      i. Kitz Corporation.
      j. Legend Valve.
      k. Milwaukee Valve Company.
      l. NIBCO INC.
      m. Norriseal; a Dover Corporation company.
      n. Red-White Valve Corporation.
      o. Spence Strainers International; a division of CIRCOR International, Inc.
      p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-67, Type I.
      b. CWP Rating: 200 psig.
      c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
      d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
      e. Seat: EPDM.
      f. Stem: One- or two-piece stainless steel.
      g. Disc: Aluminum bronze.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Kennedy Valve; a division of McWane, Inc.
      b. Shurjoint Piping Products.
      c. Tyco Fire Products LP; Grinnell Mechanical Products.
      d. Victaulic Company.
2. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 175 psig.
   c. Body Material: Coated, ductile iron.
   e. Disc: Coated, ductile iron.
   f. Seal: EPDM.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Hammond Valve.
      e. Kitz Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Red-White Valve Corporation.
      i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 4.
      b. CWP Rating: 200 psig.
      c. Body Design: Horizontal flow.
      e. Ends: Threaded.
      f. Disc: PTFE or TFE.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Stockham Division.
   2. Description:
      a. Standard: MSS SP-71, Type I.
      b. CWP Rating: 200 psig.
      c. Body Design: Clear or full waterway.
      d. Body Material: ASTM A 126, gray iron with bolted bonnet.
      e. Ends: Flanged.
      f. Trim: Composition.
      g. Seat Ring: Bronze.
      h. Disc Holder: Bronze.
      i. Disc: PTFE or TFE.
      j. Gasket: Asbestos free.

2.8 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.
   2. Description:
      a. Standard: MSS SP-71, Type I.
      b. CWP Rating: 200 psig.
      c. Body Design: Clear or full waterway.
      d. Body Material: ASTM A 126, gray iron with bolted bonnet.
      e. Ends: Flanged.
      f. Trim: Bronze.
      g. Gasket: Asbestos free.
      h. Closure Control: Factory-installed, exterior lever and spring.
2.9 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. APCO Willamette Valve and Primer Corporation.
      c. Crispin Valve.
      d. DFT Inc.
      e. GA Industries, Inc.
      f. Hammond Valve.
      g. Milwaukee Valve Company.
      h. NIBCO INC.
      i. Sure Flow Equipment Inc.
      j. Val-Matic Valve & Manufacturing Corp.

2. Description:
   b. CWP Rating: 200 psig.
   d. Style: Globe, spring loaded.
   e. Ends: Flanged.
   f. Seat: EPDM.

2.10 BRONZE GATE VALVES

A. Class 125, RS Bronze Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Crane Co.; Crane Valve Group; Stockham Division.
      e. Hammond Valve.
      f. Kitz Corporation.
      g. Milwaukee Valve Company.
      h. NIBCO INC.
      i. Powell Valves.
      j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      k. Zy-Tech Global Industries, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 200 psig.
   d. Ends: Threaded or solder joint.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron, bronze, or aluminum.

2.11 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Nonmetallic Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Stockham Division.
      c. NIBCO INC.
      d. Red-White Valve Corporation.

2. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 200 psig.
   d. Ends: Threaded or solder joint.
   e. Stem: Bronze.
   f. Disc: PTFE or TFE.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron, bronze, or aluminum.
2.12 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Hammond Valve.
      e. Kitz Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Powell Valves.
      i. Red-White Valve Corporation.
      j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      k. Zy-Tech Global Industries, Inc.

2. Description:
   a. Standard: MSS SP-85, Type I.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.
3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball, butterfly, or gate valves.
3. Throttling Service: Globe, ball, or butterfly valves.
4. Pump-Discharge Check Valves:
   a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.
   b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.
   c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends. Solder joint ball valves allowed up to NPS 3.
2. Bronze Angle Valves: Class 125, nonmetallic disc.
3. Ball Valves: One piece, reduced port, bronze with bronze trim.
4. Bronze Swing Check Valves: Class 125, nonmetallic disc.
5. Bronze Gate Valves: Class 125, RS.

B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
3. Iron, Grooved-End Butterfly Valves: 175 CWP.
4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
5. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
6. Iron, Grooved-End Swing Check Valves: 300 CWP.
7. Iron, Center-Guided Check Valves: Class 125, resilient seat.

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 the following hangers and supports for plumbing system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Fiberglass pipe hangers.
   4. Metal framing systems.
   5. Fiberglass strut systems.
   6. Thermal-hanger shield inserts.
   7. Fastener systems.
   8. Pipe stands.
   9. Pipe positioning systems.
   10. Equipment supports.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
   3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
   4. Division 22 Section "Vibration for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Fiberglass pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Powder-actuated fastener systems.
   5. Pipe positioning systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Fiberglass strut systems. Include Product Data for components.
   4. Pipe stands. Include Product Data for components.
   5. Equipment supports.
C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code—Steel;" AWS D1.4, "Structural Welding Code--Reinforcing Steel;" and ASME Boiler and Pressure Vessel Code: Section IX.

B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

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 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.
15. Pre-approved equal.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.
8. Pre-approved equal.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.
   7. Pre-approved equal.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head.
      e. MKT Fastening, LLC.
      f. Powers Fasteners.
      g. Pre-approved equal.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. 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 Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  15. 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.
  16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 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 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.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. 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. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. 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.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger 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. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Fastener System Installation:
   1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

F. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


I. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

N. 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 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. 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 overhead 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 FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 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 Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
3.6 PAINTING

A. Touch 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. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

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. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Stencils.
   5. Valve tags.
   6. Warning tags.

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. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
D. Valve numbering scheme.
E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with locations of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch; stainless steel, 0.025-inch; aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches; 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
C. Background Color: Red.
D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
G. Fasteners: Stainless-steel rivets or self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch; stainless steel, 0.025-inch; aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.
B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.
2. Provide framed ready-to-hang water valve shut-off location directory.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire or reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as “DANGER,” “CAUTION,” or “DO NOT OPERATE.”

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
   b. Hot Water: 2 inches, round.
2. Valve-Tag Color:
   a. Cold Water: Natural or green.
   b. Hot Water: Natural or green.
3. Letter Color:
   a. Cold Water: Black or white.
   b. Hot Water: Black or white.
3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553
SECTION 220719 - PLUMBING PIPING 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 ACTION SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, flanges, valves, and specialties.
   3. Detail removable insulation at piping specialties, equipment connections, and access panels.
   4. Detail application of field-applied jackets and fitting covers.

C. LEED Submittals:
   1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
   2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.3 QUALITY ASSURANCE

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

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.4 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.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on piping segments that have satisfactory test results.
PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Plumbing Piping Insulation Schedule" for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000-Degree Pipe Insulation.
      c. Owens Corning; Fiberglas Pipe Insulation.
      d. Pre-approved equal.

   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.

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
      d. Pre-approved equal.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Foster Brand; 30-80/30-90.
      b. Vimasco Corporation; 749.
      c. Pre-approved equal.

   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Products: Subject to compliance with requirements, provide one of the following:
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Flexible Elastomeric Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand; CP-76.
   b. Foster Brand; 30-45.
   c. Pittsburgh Corning Corporation; Pittseal 444.
   d. Pre-approved equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants and PVC Jacket Flashing 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 100 to plus 300 deg F.
5. For indoor applications, sealants shall have a VOC content of 420 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.
   e. Pre-approved equal.
2. Adhesive: As recommended by jacket material manufacturer.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI; 428 AWF ASJ.
   b. Avery Dennison Corporation; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. Pre-approved equal.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI; 370 White PVC tape.
      b. Compac Corporation; 130.
      c. Venture Tape; 1506 CW NS.
      d. Pre-approved equal.
   2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS
A. Staples for Hot Service Only: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.10 PROTECTIVE SHIELDING GUARDS
A. Protective Shielding Pipe Covers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
      b. Plumberex.
      c. Truebro; a brand of IPS Corporation.
      d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
      e. Pre-approved equal.
   2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at 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, no penetrations of the insulation shall occur at hangers, supports, anchors, and other projections. Seal joints and seams 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 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistant joint sealers.

C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

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-retarder 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. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as 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. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges 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. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services, 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.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Finish exposed surfaces with a PVC jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install 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.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FIELD QUALITY CONTROL

A. All insulation applications will be considered defective Work if inspection reveals noncompliance with requirements.

END OF SECTION 220719
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. Section Includes:
1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
4. Flexible connectors.
5. Escutcheons.
6. Sleeves and sleeve seals.
7. Wall penetration systems.

B. Related Section:
1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

C. Reference Documents:
2. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications.

D. Definitions:
1. Definitions shall be in accordance with local plumbing codes and ASTM F 2389.

1.3 SUBMITTALS
A. Product Data: For the following products:
1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.
5. Backflow preventers and vacuum breakers.
7. Sleeves and sleeve seals.
8. Water penetration systems.


C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Fire-suppression-water piping.
2. Domestic water piping.
3. Compressed air piping.
4. HVAC hydronic piping.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 61 for potable domestic water piping and components.

C. Material shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

D. Material shall comply with manufacturers specifications.

E. Special Engineered products shall be certified by NSF International as complying with NSF 14.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Architect, Construction Manager, or Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not proceed with interruption of water service without Architect's, Construction Manager's, or Owner's written permission.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
   4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
   5. Copper Pressure-Seal-Joint Fittings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Elkhart Products Corporation; Industrial Division.
         2) NIBCO INC.
         3) Viega; Plumbing and Heating Systems.
         4) Pre-approved equal.
      b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      c. NPS 2-1/2 to NPS 4: Cast-bronce or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
   6. Copper-Tube Extruded-Tee Connections:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) T-DRILL Industries Inc.
         2) Pre-approved equal.
      b. Description: Tee formed in copper tube according to ASTM F 2014.
   7. Grooved-Joint Copper-Tube Appurtenances:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Anvil International.
         2) Shurjoint Piping Products.
         3) Victaulic Company.
         4) Pre-approved equal.
      b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
      c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
   2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
      a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
   2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Form: Sheet or tube.

C. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.

D. Color: Black or natural.

2.6 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.7 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Dresser Piping Specialties.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc; a Sensus company.
g. Viking Johnson; c/o Mueller Co.
h. Pre-approved equal.

2.8 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Central Plastics Company.
   c. EPCO Sales, Inc.
   d. Hart Industries International, Inc.
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Wilkins Water Control Products.
   g. Pre-approved equal.
2. Description:
   a. Pressure Rating: 150 psig at 180 deg F.
   b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Central Plastics Company.
   c. EPCO Sales, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Pre-approved equal.
2. Description:
   a. Factory-fabricated, bolted, companion-flange assembly.
   b. Pressure Rating: 175 psig minimum.
   c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
   e. Pre-approved equal.
2. Description:
   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig.
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Calpico, Inc.
   b. Lochinvar Corporation.
   c. Pre-approved equal.
2. Description:
   a. Galvanized-steel coupling.
   b. Pressure Rating: 300 psig at 225 deg F.
   c. End Connections: Female threaded.
   d. Lining: Inert and noncorrosive, thermoplastic.
F. **Dielectric Nipples:**
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Perfection Corporation; a subsidiary of American Meter Company.
   b. Precision Plumbing Products, Inc.
   c. Victaulic Company.
   d. Pre-approved equal.
2. **Description:**
   a. Electroplated steel nipple complying with ASTM F 1545.
   b. Pressure Rating: 300 psig at 225 deg F.
   c. End Connections: Male threaded or grooved.
   d. Lining: Inert and noncorrosive, propylene.

2.9 **FLEXIBLE CONNECTORS**
A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
7. Metraflex, Inc.
8. Proco Products, Inc.
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company.
12. Pre-approved equal.
B. **Bronze-Hose Flexible Connectors:** Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   2. End Connections NPS 2) and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. **Stainless-Steel-Hose Flexible Connectors:** Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.10 **ESCUCHIONS**
A. **General:** Manufactured ceiling, floor, and wall escutcheons and floor plates.
B. **One Piece, Cast Brass:** Polished, chrome-plated finish with setscrews.
C. **One Piece, Deep Pattern:** Deep-drawn, box-shaped brass with chrome-plated finish.
D. **One Piece, Stamped Steel:** Chrome-plated finish with setscrew.
E. **Split Casting, Cast Brass:** Polished, chrome-plated finish with concealed hinge and setscrew.
F. **Split Plate, Stamped Steel:** Chrome-plated finish with concealed hinge, setscrew.
G. **One-Piece Floor Plates:** Cast-iron flange with holes for fasteners.
H. **Split-Casting Floor Plates:** Cast brass with concealed hinge.

2.11 **SLEEVES**
A. **Cast-Iron Wall Pipes:** Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

G. 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 setscrews.

2.12 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex, Inc.
   4. Pipeline Seal and Insulator, Inc.
   5. Pre-approved equal.

B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel or stainless steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or stainless steel of length required to secure pressure plates to sealing elements.

2.13 GROUT


B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

H. Install domestic water piping level without pitch and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company’s requirements.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. 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.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping adjacent to equipment and specialties to allow service and maintenance.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Brazed Joints: Join copper tube and fittings according to CDA’s "Copper Tube Handbook," "Brazed Joints" Chapter.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA’s "Copper Tube Handbook."

E. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. 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.

G. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.

H. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.

I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

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

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

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. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

E. 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. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. NPS 2 and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   6. NPS 6: 10 feet with 5/8-inch rod.
   7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 2 and Smaller: 32 inches with 3/8-inch rod.

G. Install hangers for vertical PEX piping every 48 inches

H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 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 water-service piping with shutoff valve; extend and connect to the following:
   1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
   4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.
B. Escutcheons for New Piping:
1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.

I. Seal space outside of sleeves in concrete slabs and walls with grout.

J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

K. Install sleeve materials according to the following applications:
1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE, molded PVC, or steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe or stack sleeve fittings.
   a. Extend sleeves 2 inches above finished floor level.
   b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges.
      Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
3. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE, molded PVC, or steel pipe.
4. Sleeves for Piping Passing through Exterior Concrete Walls:
   a. Steel pipe sleeves for pipes smaller than NPS 6.
   b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
   c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
   d. Do not use sleeves when wall penetration systems are used.
5. Sleeves for Piping Passing through Interior Concrete Walls:
   a. Steel pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.
3.12 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 WALL PENETRATION SYSTEM INSTALLATION

A. Install wall penetration systems in new, exterior concrete walls.

B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.14 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section “Identification for Plumbing Piping and Equipment” for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.15 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      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 final inspection for 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 tests or inspections, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. 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.
   5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   6. Prepare reports for tests and for corrective action required.

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

E. Prepare test and inspection reports.

3.16 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.17 CLEANING

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

B. Clean non-potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.18 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
   1. Soft copper tube, ASTM B 88, Type K or ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
   1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern mechanical-joint fittings; and mechanical joints.
   2. Push-on-joint, ductile-iron pipe; standard- or compact-pattern push-on-joint fittings; and gasketed joints.

F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper solder-joint fittings; and brazed or soldered joints.
2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper solder-joint fittings; and brazed or soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

H. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper solder-joint fittings; and brazed or soldered joints.
   2. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints.

3.19 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

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. Vacuum breakers.
   2. Backflow preventers.
   5. Temperature-actuated water mixing valves.
   7. Outlet boxes.
   8. Hose bibbs.
   9. Wall hydrants.
  10. Drain valves.
  12. Air vents.

B. Related Sections include the following:
   1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
   2. Division 22 Section "Domestic Water Piping" for water meters.
   3. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.
   4. Division 22 Section "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
   5. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
   6. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

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

1.4 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:
   2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Cash Acme.
      c. Conbraco Industries, Inc.
      d. FEBCO; SPX Valves & Controls.
      e. Rain Bird Corporation.
      f. Toro Company (The); Irrigation Div.
      g. Watts Industries, Inc.; Water Products Div.
      h. Zurn Plumbing Products Group; Wilkins Div.
      i. Pre-approved equal.
   3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
   5. Inlet and Outlet Connections: Threaded.
   6. Finish: Rough bronze or chrome plated where in public view.

B. Hose-Connection Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Arrowhead Brass Products, Inc.
      b. Cash Acme.
      c. Conbraco Industries, Inc.
      d. Legend Valve.
      e. MIFAB, Inc.
      f. Prier Products, Inc.
      g. Watts Industries, Inc.; Water Products Div.
      h. Woodford Manufacturing Company.
      i. Zurn Plumbing Products Group; Light Commercial Operation.
      j. Zurn Plumbing Products Group; Wilkins Div.
      k. Pre-approved equal.
   5. Finish: Chrome or nickel plated or rough bronze where in public view.

C. Pressure Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Conbraco Industries, Inc.
      c. FEBCO; SPX Valves & Controls.
      d. Flomatic Corporation.
      e. Toro Company (The); Irrigation Div.
      g. Zurn Plumbing Products Group; Wilkins Div.
      h. Pre-approved equal.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
   5. Accessories:
      a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      c. Woodford Manufacturing Company.
      d. Zurn Plumbing Products Group; Wilkins Div.
      e. Pre-approved equal.
5. End Connections: Threaded.
6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   c. Pre-approved equal.
3. Operation: Continuous-pressure applications.
4. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   d. Zurn Plumbing Products Group; Wilkins Div.
   e. Pre-approved equal.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
5. End Connections: Union, solder joint.

B. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   d. Zurn Plumbing Products Group; Wilkins Div.
   e. Pre-approved equal.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through; vertical inlet, horizontal center section, and vertical outlet; or vertical where space constraints require, flow.
8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

C. Double-Check Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   d. Zurn Plumbing Products Group; Wilkins Div.
   e. Pre-approved equal.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
a. Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Beverage-Dispensing-Equipment Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   c. Zurn Plumbing Products Group; Wilkins Div.
   d. Pre-approved equal.
3. Operation: Continuous-pressure applications.

E. Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   d. Zurn Plumbing Products Group; Wilkins Div.
   e. Pre-approved equal.
3. Operation: Continuous-pressure applications.
5. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cash Acme.
   b. Lancer Corporation.
   d. Pre-approved equal.
3. Operation: Continuous-pressure applications.

G. Double-Check, Detector-Assembly Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   d. Zurn Plumbing Products Group; Wilkins Div.
   e. Pre-approved equal.
2. Standard: ASSE 1048 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
7. Configuration: Designed for horizontal, straight through; vertical inlet, horizontal center section, and vertical outlet; or vertical flow where space constraints require.
8. Accessories:
   a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
   b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

H. Hose-Connection Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   c. Woodford Manufacturing Company.
   d. Pre-approved equal.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

I. Backflow-Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   c. Flromatic Corporation.
   e. Zurn Plumbing Products Group; Wilkins Div.
   f. Pre-approved equal.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts Industries, Inc.; Water Products Div. for 4" valves and larger, no exceptions allowed.
   b. Wilkins, Cla-Val, Febco, or Conbraco for valves smaller than 4", no other manufacturer’s allowed.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CLA-VAL Automatic Control Valves.
   b. Flromatic Corporation.
   c. OCV Control Valves.
   e. Watts Industries, Inc.; Watts ACV.
   f. Zurn Plumbing Products Group; Wilkins Div.
   g. Pre-approved equal.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
   a. Pattern: Angle- or globe-valve design.
   b. Trim: Stainless steel.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. ITT Industries; Bell & Gossett Div.
   c. NIBCO INC.
   d. TAC Americas.
   e. Taco, Inc.
   g. Pre-approved equal.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Flo Fab Inc.
   c. ITT Industries; Bell & Gossett Div.
   d. NIBCO INC.
   e. TAC Americas.
   g. Pre-approved equal.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Crane Co.; Crane Valve Group; Stockham Div.
      e. Hammond Valve.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Red-White Valve Corp.
      i. Pre-approved equal.
   2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
   3. Pressure Rating: 400-psig minimum CWP.
   4. Size: NPS 2 or smaller.
   5. Body: Copper alloy.
   6. Port: Standard or full port.
   7. Ball: Chrome-plated brass.
   8. Seats and Seals: Replaceable.
   9. End Connections: Solder joint or threaded.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
   2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
   3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   4. Screen: Stainless steel with round perforations, unless otherwise indicated.
   5. Perforation Size:
      a. Strainers NPS 2 and Smaller: 0.020 inch.
      b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
      c. Strainers NPS 5 and Larger: 0.10 inch.

2.6 OUTLET BOXES

A. Clothes Washer Outlet Boxes:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Guy Gray Manufacturing Co., Inc.
      c. IPS Corporation.
      d. LSP Products Group, Inc.
      e. Oatey.
      f. Plastic Oddities; a division of Diverse Corporate Technologies.
      g. Symmons Industries, Inc.
      h. Watts Industries, Inc.; Water Products Div.
      i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
      j. Zurn Plumbing Products Group; Light Commercial Operation.
      k. Pre-approved equal.
4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Guy Gray Manufacturing Co., Inc.
   c. IPS Corporation.
   d. LSP Products Group, Inc.
   e. Oatey.
   f. Plastic Oddities; a division of Diverse Corporate Technologies.
   g. Pre-approved equal.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.7 HOSE BIBBS

A. Hose Bibbs:
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
8. Finish for Equipment Rooms: Rough bronze, chrome or nickel plated.
9. Finish for Service Areas: Rough bronze or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   c. Prier Products, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Woodford Manufacturing Company.
   h. Zurn Plumbing Products Group; Light Commercial Operation.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.
   j. Pre-approved equal.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
12. Operating Keys(s): One with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Arrowhead Brass Products, Inc.
      b. Mansfield Plumbing Products LLC.
      d. Prier Products, Inc.
      g. Woodford Manufacturing Company.
      h. Zurn Plumbing Products Group; Light Commercial Operation.
      i. Pre-approved equal.
   2. Standard: ASSE 1019, Type A or Type B.
   3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
   4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
   7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

2.9 POST HYDRANTS

A. Nonfreeze, Draining-Type Post Hydrants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. MIFAB, Inc.
      b. Prier Products, Inc.
      c. Simmons Manufacturing Co.
      e. Tyler Pipe; Wade Div.
      f. Watts Drainage Products Inc.
      g. Woodford Manufacturing Company.
      h. Zurn Plumbing Products Group; Light Commercial Operation.
      i. Zurn Plumbing Products Group; Specification Drainage Operation.
      j. Pre-approved equal.
   2. Standard: ASME A112.21.3M.
   3. Type: Nonfreeze, exposed-outlet post hydrant.
   4. Operation: Loose key.
   5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
   9. Drain: Designed with hole to drain into ground when shut off.
   10. Vacuum Breaker: Nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7 on outlet.
   11. Operating Key(s): Two with each loose-key-operation wall hydrant.

2.10 DRAIN ValVES

A. Ball-Valve-Type, Hose-End Drain Valves:
   2. Pressure Rating: 400-psig minimum CWP.
   4. Body: Copper alloy.
   5. Ball: Chrome-plated brass.
   8. Inlet: Threaded or solder joint.

2.11 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. PPP Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.
   j. Pre-approved equal.
3. Type: Metal bellows or copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.12 AIR VENTS

A. Bolted-Construction Automatic Air Vents:
1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.

B. Welded-Construction Automatic Air Vents:
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install 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 in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.
   4. Install backflow preventer between 12” above floor and 60” above floor so it is easily accessible without the use of a ladder.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install thermometers and water regulators if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
   1. Install shutoff valve on outlet if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

J. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

K. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

L. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.

M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

N. Install water hammer arresters in water piping according to PDI-WH 201.

O. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping 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."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Pressure vacuum breakers.
   2. Intermediate atmospheric-vent backflow preventers.
   3. Reduced-pressure-principle backflow preventers.
   5. Carbonated-beverage-machine backflow preventers.
   7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
  10. Calibrated balancing valves.
  11. Primary, thermostatic, water mixing valves.
  14. Primary water tempering valves.
  15. Outlet boxes.
17. Supply-type, trap-seal primer valves.
18. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
1. Test each reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119
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 the following for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

B. Related Sections include the following:
   1. Division 22 Section "Sanitary Sewerage Pumps."

1.3 DEFINITIONS


B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:
   1. Sovent Drainage System: Include plans, elevations, sections, and details.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

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

B. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International.

C. CISPI Hubless Couplings (CISPI 310) shall be marked with NSF International.
D. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

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 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class; manufactured by AB&I, Charolotte, or Tyler.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301. manufactured by AB&I, Charolotte, or Tyler.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) ANACO.
      2) Mission Rubber Co.
      3) Tyler Pipe; Soil Pipe Div.
      4) Pre-approved equal.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) ANACO/Husky SD 4000.
      2) Clamp-All Corp.-125.
      3) Pre-approved equal.

3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) MG Piping Products Co.
      2) Pre-approved equal.

2.5 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.

C. Pressure Fittings:

D. Grooved-Joint Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International.
   b. Star Pipe Products; Star Fittings Div.
   c. Victaulic Company.
   d. Ward Manufacturing, Inc.
   e. Pre-approved equal.
2. Grooved-End, Steel-Piping Fittings: ASTM A47/A47M, galvanized, malleable-iron casting; ASTM A106, galvanized-steel pipe; or ASTM A536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.6 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B306, drainage tube, drawn temper.

B. Hard Copper Tube: ASTM B88, Type L, water tube, drawn temper.
   2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.7 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D2665, drain, waste, and vent.
   1. PVC Socket Fittings: ASTM D2665, socket type, made to ASTM D3311, drain, waste, and vent patterns.

B. Solvent Cement and Adhesive Primer:
   1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Fernco, Inc.
      c. Logan Clay Products Company (The).
      d. Mission Rubber Co.
      e. NDS, Inc.
      f. Plastic Oddities, Inc.
      g. Pre-approved equal.
   2. Sleeve Materials:
      b. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
      c. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

B. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and
assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. EBAA Iron Sales, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products; Star Fittings Div.
   d. Pre-approved equal.

C. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. SIGMA Corp.
      b. Pre-approved equal.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.

B. Form: Sheet or tube.

C. Color: Black or natural.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping shall be the following:
   1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

C. Aboveground, vent piping shall be the following:
   1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

D. Underground, soil, waste, and vent piping NPS 15 and smaller shall be the following:
   1. Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
   2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   3. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

E. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
   1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
   2. Steel pipe, pressure fittings, and threaded joints.

F. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be any of the following:
   1. Steel pipe, pressure fittings, and threaded joints.
   2. Grooved-end steel pipe, grooved-joint system fittings and couplings, and grooved joints.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

E. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.

F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
   1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
   1. Install encasement on piping according to ASTM A 674 or AWWA C105.

I. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section “Common Work Results for Plumbing.”

J. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

L. 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.

M. 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.

N. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

O. Install engineered soil and waste drainage and vent piping systems as follows:
   2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
   3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

P. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

Q. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.

R. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

S. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.
T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."


C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
   1. Install gate or full-port ball valve for piping NPS 2 and smaller.
   2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
   1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
   2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
   3. Install backwater valves in accessible locations.
   4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

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. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 12 feet with 1/2-inch rod.
5. NPS 3: 15 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 15 feet with 5/8-inch rod.
7. NPS 6: 15 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 15 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 3: 96 inches with 1/2-inch rod.
3. NPS 4: 108 inches with 1/2-inch rod.
4. NPS 6: 10 feet with 5/8-inch rod.

J. Install supports for vertical stainless-steel piping every 10 feet.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main or sanitary manhole.
2. Sewage Pumps: To sewage pump discharge.
3.8 FIELD QUALITY CONTROL

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

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary 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. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   2. 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.
   3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 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 drainage piping specialties:
   1. Backwater valves.
   2. Cleanouts.
   3. Floor drains.
   4. Trench drains.
   5. Channel drainage systems.
   6. Roof flashing assemblies.
   7. Through-penetration firestop assemblies.

B. Related Sections include the following:
   1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS


B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
   1. Grease interceptors.
   2. Grease removal devices.
   3. Oil interceptors.

B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.
1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

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.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. MIFAB, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
      g. Pre-approved equal.
   3. Size: Same as connected piping.
   5. Cover: Cast iron with bolted or threaded access check valve.
   6. End Connections: Hub and spigot or hubless.
   7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed or open for airflow unless subject to backflow condition.
   8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      c. Watts Drainage Products Inc.
      d. Zurn Plumbing Products Group; Specification Drainage Operation.
      e. Pre-approved equal.
   2. Size: Same as floor drain outlet.
   3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
   4. Check Valve: Removable ball float.
   5. Inlet: Threaded.
   6. Outlet: Threaded or spigot.

C. Horizontal, Plastic Backwater Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Canplas LLC.
      b. IPS Corporation.
      c. NDS Inc.
d. Oatey.
e. Plastic Oddities; a division of Diverse Corporate Technologies.
f. Sioux Chief Manufacturing Company, Inc.
g. Zurn Plumbing Products Group; Light Commercial Operation.
h. Pre-approved equal.

2. Size: Same as connected piping.
3. Body: ABS or PVC.
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Pre-approved equal.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Oatey.
   c. Sioux Chief Manufacturing Company, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.
   h. Josam Company; Josam Div.
   i. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   j. Pre-approved equal.
2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule; heavy-duty, adjustable housing; or threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Outlet Connection: Threaded
6. Closure: Brass plug with straight threads and gasket; or brass plug with tapered threads.
7. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
9. Frame and Cover Shape: Round or square in tiled areas.
10. Top Loading Classification: Extra Heavy in Service, Equipment and Warehouse Areas or Medium Duty.
11. Riser: ASTM A 74, Extra-Heavy in Service, Equipment and Warehouse Areas or Service class, cast-iron drainage pipe fitting and riser to cleanout.
13. Size: Same as connected branch.
15. Closure: Stainless steel with seal.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Pre-approved equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head; drilled-and-threaded, brass, or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, deep, chrome-plated bronze, flat, chrome-plated brass or stainless-steel cover plate with countersunk screw.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. MIFAB, Inc.
      c. Prier Products, Inc.
      e. Tyler Pipe; Wade Div.
      f. Watts Drainage Products Inc.
      g. Zurn Plumbing Products Group; Specification Drainage Operation.
      h. Pre-approved equal.
   2. See Schedule on Drawings.

2.4 TRENCH DRAINS

A. Trench Drains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. MIFAB, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
      g. Pre-approved equal.
   3. Material: Ductile or gray iron.
   4. See Schedule on Drawings.

2.5 CHANNEL DRAINAGE SYSTEMS

A. Stainless-Steel Channel Drainage Systems:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Blucher-Josam Div.
      b. MultiDrain Systems.
      c. Zurn Plumbing Products Group; Flo-Thru Operation.
      d. Pre-approved equal.
   2. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
      a. Standard: ASME A112.3.1, for trench drains.
      b. Channel Sections: Interlocking-joint, stainless-steel with level invert.
         1) Dimensions: 5.8 inches wide. Include number of units required to form total lengths indicated.
      c. Grates: Manufacturer's designation "heavy or medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.
         1) Material: Stainless steel
         2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
      d. Covers: Solid stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
      e. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
      f. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
   3. See Schedule on Drawings.
B. Polymer-Concrete Channel Drainage Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ACO Polymer Products, Inc.
   b. Josam Company; Mea-Josam Div.
   d. Pre-approved equal.
2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
   a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
      1) Dimensions: 4-inch inside width. Include number of units required to form total lengths indicated.
      2) Frame: Gray-iron or galvanized steel for grates.
   b. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
      1) Material: Ductile iron
      2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
   c. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections.
   d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
   e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
   f. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps. Include rounded bottom, with level invert and with NPS 4 outlets in number and locations indicated.
      1) Dimensions: 5-inch inside width and 9-3/4 inches deep. Include number of units required to form total lengths indicated.
      2) Frame: Gray-iron or galvanized steel for grates.

3. See Schedule on Drawings.

C. Polymer-Concrete Sediment Interceptor:
1. Description: 27-inch-square, precast, polymer-concrete body, with outlets in number and sizes indicated. Include 24-inch-square, gray-iron slotted grate.
2. Frame: Gray-iron or galvanized steel for grate.

D. FRP Channel Drainage Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ACO Polymer Products, Inc.
   c. Josam Company; Mea-Josam Div.
   e. Zurn Plumbing Products Group; Flo-Thru Operation.
   f. Pre-approved equal.
2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
   a. Channel Sections: Interlocking-joint, sloped-invert, FRP modular units, with end caps. Include flat, rounded, or inclined inside bottom, with outlets in number, sizes, and locations indicated.
      1) Dimensions: 4 or 6 inches wide. Include number of units required to form total lengths indicated.
      2) Frame: Manufacturer's standard metal for grates.
   b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
      1) Material: Fiberglass, galvanized steel, or gray iron.
      2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
   c. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
   d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
   e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
   f. See Schedule on Drawings.

2.6 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.
c. Pre-approved equal.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.7 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ProSet Systems Inc.
      b. Hilti, Inc.
      c. 3M, Inc.
      d. Pre-approved equal.
   2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
   3. Size: Same as connected soil, waste, or vent stack.
   4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
   6. Special Coating: Corrosion resistant on interior of fittings.

2.8 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:
   1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
   2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2: 4-inch-minimum water seal.
      b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:
   1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

2.9 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: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.


E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

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.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
H. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.

I. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

J. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

K. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

L. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

M. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

N. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

O. Assemble open drain fittings and install with top of hub 2 inches above floor.

P. Install deep-seal traps on floor drains and other waste outlets, if indicated.

Q. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

R. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

S. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
   1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
   2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
   3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
   4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

T. Install wood-blocking reinforcement for wall-mounting-type specialties.

U. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

V. 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. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

D. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
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: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs 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 and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319
SECTION 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 the following conventional plumbing fixtures and related components:

1. Faucets for lavatories, bathtubs, bathtub/showers, showers and sinks.
2. Fittings for bathtubs, bathtub/showers and showers.
3. Flushometers.
4. Toilet seats.
5. Protective shielding guards.
6. Fixture supports.
7. Interceptors.
8. Shower receptors.
10. Water closets.
11. Urinals.
12. Lavatories.
13. Commercial sinks.
15. Individual shower enclosures.
18. Service sinks and Janitor’s sinks.

B. Related Sections include the following:
1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Drinking Fountains/Water Coolers."

1.3 DEFINITIONS


B. Accessible Fixture:  Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer:  Cast-filled-polymer-plastic material.  This material includes cultured-marble and solid-surface materials.

D. Cultured Marble:  Cast-filled-polymer-plastic material with surface coating.

E. Fitting:  Device that controls the flow of water into or out of the 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.

F. FRP:  Fiberglass-reinforced plastic.

G. PMMA:  Polymethyl methacrylate (acrylic) plastic.

H. PVC:  Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include operation and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   5. Porcelain-Enamed, Formed-Steel Fixtures: ASME A112.19.4M.
   10. Vitreous-China Fixtures: ASME A112.19.2M.
   13. Whirlpool Bathtub Fittings: ASME A112.19.8M.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
   2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   5. Hose-Connection Vacuum Breakers: ASSE 1011.
I. Comply with the following applicable standards and other requirements specified for bathtub, bathtub/shower 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.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   2. Brass and Copper Supplies: ASME A112.18.1.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Disposers: ASSE 1008 and UL 430.
   3. Floor Drains: ASME A112.6.3.
   5. Off-Floor Fixture Supports: ASME A112.6.1M.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures of unit shell.
      b. Faulty operation of controls, blowers, pumps, heaters, and timers.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period for Commercial Applications: Three years from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Faucet Washers and O-Rings: Equal to 10 percent of amount, but no fewer than 2, of each type and size installed.
   2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount, but no fewer than 2, of each type and size installed.
   3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 2 of each type.
   4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
   5. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
   6. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
PART 2 - PRODUCTS

2.1 FAUCETS

A. Lavatory Faucets:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Chicago Faucets.
      b. Kohler Co.
      c. T&S Brass
      d. Pre-approved equal.
   2. See Schedule on Drawings.

2.2 FLUSHOMETERS

A. Flushometers: Manually operated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Sloan Valve Company.
      b. Toto.
      c. Pre-approved equal.
   2. Description: Flushometer for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
      a. Internal Design: Diaphragm operation.
      b. Style: Exposed.
      c. Inlet Size: NPS 1 or NPS 1-1/4.
      d. Trip Mechanism: Oscillating, lever-handle actuator.
   3. See Schedule on Drawings.

2.3 TOILET SEATS

A. Toilet Seats:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Church Seats.
      c. Eljer.
      d. Kohler Co.
      e. Olsonite Corp.
      f. Pre-approved equal.
   2. Description: Toilet seat for water-closet-type fixture shall incorporate the following unless indicated otherwise:
      a. Material: Molded, solid plastic with antimicrobial agent.
      b. Configuration: Open front without cover.
      c. Size: Elongated.
      d. Hinge Type: SS, self-sustaining, check.
      e. Class: Heavy-duty commercial.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers: Where indicated or scheduled.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Insul-Tect Products Co.
      b. McGuire Manufacturing Co., Inc.
      c. Plumberex Specialty Products Inc.
      d. TRUEBRO, Inc.
      e. Zurn Plumbing Products Group.
      f. Pre-approved equal.
   2. Description: Manufactured PVC plastic pipe covers over pipe insulation or insulation wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures: Where indicated or scheduled.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Description: Manufactured plastic enclosure for concealing plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.5 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Josam Company.
   3. Wade.
   5. Zurn.
   6. Pre-approved equal.

B. Water-Closet Supports:
   1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounted, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; 4" waste and 2" vent; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
      a. Wade 310 Series.

C. Urinal Supports:
   1. Description: Type II, urinal carrier with hanger and bearing plates for wall-mounting, urinal-type fixture. Include steel uprights with feet.
      a. Wade 400-AM11 or pre-approved equal.
      a. Wade 400-AM11-M36 or pre-approved equal.

D. Wall-Hung Lavatory Supports:
   1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
      a. Wade 520 or pre-approved equal.
   2. Accessible-Fixture Support: Include rectangular steel uprights with feet.
      a. Wade 520-M36 or pre-approved equal.

2.6 INTERCEPTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Josam Company.
   2. MIFAB Manufacturing Inc.
   4. Wade.
   5. Watts.
   6. Zurn.
   7. Pre-approved equal.

B. Hair Interceptors:
   1. Description: Manufactured unit with removable screen or strainer and removable cover; designed to trap and retain hair.
      a. Material: Brass or stainless-steel body.
      b. Pipe Connections: NPS 1-1/4 or NPS 1-1/2.

C. Sediment Interceptors:
   1. Description: Manufactured unit with removable screens or strainer and removable cover; designed to trap and retain waste material.
      a. Material: Cast-iron or steel body with acid-resistant lining and coating or stainless-steel.
      b. Pipe Connections: NPS 1-1/2 or NPS 2.

2.7 SHOWER RECEPTORS

A. Shower Receptors:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fiat Products.
   b. American Standard Companies, Inc.
   c. Kohler Co.
   d. Stern-Williams Co., Inc.
   e. Pre-approved equal.
2. See Schedule on Drawings.

2.8 DISPOSERS

A. Disposers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. In-Sink-Erator.
      b. KitchenAid.
      c. Maytag Co.
      d. Pre-approved equal.
   2. See schedule on drawings.

2.9 WATER CLOSETS

A. Water Closets:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Kohler Co.
      c. TOTO USA, Inc.
      d. Pre-approved equal.
   2. See Schedule on Drawings.

2.10 URINALS

A. Urinals:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Kohler Co.
      c. TOTO USA, Inc.
      d. Pre-approved equal.
   2. See Schedule on Drawings.

2.11 LAVATORIES

A. Lavatories:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Kohler Co.
      c. TOTO USA, Inc.
      d. Pre-approved equal.
   2. See Schedule on Drawings.

2.12 COMMERCIAL SINKS

A. Commercial Sinks: Stainless steel.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Tabco.
      b. Elkay Manufacturing Co.
      c. Kohler.
      d. Pre-approved equal.
   2. See Schedule on Drawings.

2.13 WASH FOUNTAINS

A. Wash Fountains:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. Pre-approved equal.
2. See Schedule on Drawings.

2.14 BATHTUBS

A. Bathtubs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kohler Co.
   c. TOTO, Inc.
   d. Pre-approved equal.
2. See Schedule on Drawings.

2.15 INDIVIDUAL SHOWERS ENCLOSURES

A. Shower Enclosures:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aquatic.
   b. Aqua Glass Corporation.
   c. Florestone Products Co., Inc.
   d. LASCO Bathware.
   e. Fiat Products.
   f. Kohler Co.
   g. Pre-approved equal.
2. See Schedule on Drawings.

2.16 GROUP SHOWERS

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

B. See Schedule on Drawings.

2.17 KITCHEN SINKS

A. Sinks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kohler Co.
   b. Elkay.
   c. Pre-approved equal.
2. See Schedule on Drawings.

2.18 SERVICE SINKS/JANITOR’S SINKS

A. Service Sinks/Janitor’s Sinks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fiat Products.
   b. Florestone Products Co., Inc.
   c. Stern-Williams Co., Inc.
   d. Pre-approved equal.
2. See Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   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-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounted fixtures with tubular waste piping attached to supports.

F. Install floor-mounted, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounted fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
   1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

N. Install toilet seats on water closets.

O. Install trap-seal liquid in dry urinals.

P. 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.

Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

R. 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.

S. Install shower flow-control fittings with specified maximum flow rates in shower arms.

T. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
V. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons shall be chrome plated.

W. Set bathtubs, shower receptors and service sink basins in leveling bed of cement grout.

X. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

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.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.
B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000
SECTION 230500 - COMMON WORK RESULTS 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. Coordination procedures.
2. Piping materials and installation instructions common to most piping systems.
3. Transition fittings.
4. Dielectric fittings.
5. Mechanical sleeve seals.
7. Escutcheons.
8. Grout.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 GENERAL COORDINATION PROCEDURES

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 performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Construction Manager and separate contractors if coordination of their Work is required.

C. Administrative Procedures:  Coordinate scheduling and timing of required administrative procedures with other construction activities 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.

D. Conservation:  Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.  Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.
1.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
   a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
   b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
   c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
   f. Indicate required installation sequences.
   g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section "Submittal Procedures."
1.5 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, 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 chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. CPVC: Chlorinated polyvinyl chloride plastic.
   2. PE: Polyethylene plastic.
   3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.6 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.7 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.8 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.
1.9 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 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 specified.

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, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

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. CPVC Piping: ASTM F 493.
   2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Esilon Thermoplastics.
b. Pre-approved equal.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thompson Plastics, Inc.
      b. Pre-approved equal.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. NIBCO INC.
      b. NIBCO, Inc.; Chemtrol Div.
      c. Pre-approved equal.

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: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Eclipse, Inc.
      d. Epco Sales, Inc.
      g. Zurn Industries, Inc.; Wilkins Div.
      h. Pre-approved equal.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300-psig minimum working pressure as required to suit system pressures.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      e. Pre-approved equal.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
      e. Pre-approved equal.
   2. Separate companion flanges and steel bolts and nuts shall have 150 or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Calpico, Inc.
      b. Lochinvar Corp.
      c. Pre-approved equal.

G. 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: Subject to compliance with requirements, provide products by one of the following:
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Victaulic Co. of America.
   e. Pre-approved equal.

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: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
      e. Pre-approved equal.

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: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.


G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

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-Profile 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 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.
2. Design Mix: 5000-psi 28-day compressive strength.

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 on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. 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 Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
   f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
   g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
   h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
   i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and screw or spring clips
   j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
   k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
   l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.
N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   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. Steel Pipe Sleeves: For pipes smaller than NPS 6
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
      c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section “Sheet Metal Flashing and Trim” for flashing.
         1) Seal space outside of sleeve fittings with grout.
   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. Refer to Division 07 Section “Joint Sealants” for materials and installation.

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.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. 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.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section “Penetration Firestopping” for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 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 copper-phosphorus brazing filler metal complying with AWS A5.8.
F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

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 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
   1. Construct concrete bases a minimum of 4 inches and a maximum of 6 inches deep, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 230500
SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
   1. Trapeze pipe hangers.
   2. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

B. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-
actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. 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.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. 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 carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system 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.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. 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. 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.
   8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
   9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
   3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529
SECTION 230553 - HVAC SYSTEM IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:
   1. Equipment nameplates.
   2. Equipment markers.
   3. Equipment signs.
   4. Access panel and door markers.
   5. Pipe markers.
   6. Duct markers.
   7. Valve tags.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE


PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
   1. Data:
      a. Manufacturer, product name, model number, and serial number.
      b. Capacity, operating and power characteristics, and essential data.
      c. Labels of tested compliances.
   2. Location: Accessible and visible.
   3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
   1. Terminology: Match schedules as closely as possible.
   2. Data:
      a. Name and plan number.
      b. Equipment service.
      c. Design capacity.
      d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
   3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
   1. Data: Instructions for operation of equipment and for safety procedures.
   2. Engraving: Manufacturer’s standard letter style, of sizes and with terms to match equipment identification.
   3. Thickness: 1/16 inch, unless otherwise indicated.
   4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole 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: Full-band pipe markers extending 360 degrees around pipe at each location.
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. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.


E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
   2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme. Provide 5/32-inch hole for fastener.
   1. Material: 0.032-inch-thick brass.
   2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
   1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
   2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
   3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
   4. Fans, blowers, primary balancing dampers, and mixing boxes.
   5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
   1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
   3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
      a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
b. Meters, gages, thermometers, and similar units.
c. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
e. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
f. Fans, blowers, primary balancing dampers, and mixing boxes.
g. Packaged HVAC central-station and zone-type units.
h. Tanks and pressure vessels.
i. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
   a. Green: For cooling equipment and components.
   b. Yellow: For heating equipment and components.
   c. Orange: For combination cooling and heating equipment and components.
   d. Brown: For energy-reclamation equipment and components.
2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
4. Include signs for the following general categories of equipment:
   a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
   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, primary balancing dampers, and mixing boxes.
   f. Packaged HVAC central-station and zone-type units.
   g. Tanks and pressure vessels.
   h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

D. 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: Pretensioned 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, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
4. 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; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.4 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive on air ducts in the following color codes:
1. Green: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

   1. Valve-Tag Size and Shape:
      d. Steam: 1-1/2 inches, round.

   2. Valve-Tag Color:
      b. Hot Water: Red.
      c. Gas: Yellow.

   3. Letter Color:
      c. Gas: White.

3.6 ADJUSTING AND CLEANING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

B. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553
SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.
   2. Balancing Hydronic Piping Systems:
      a. Variable-flow hydronic systems.

1.2 DEFINITIONS

B. TAB: Testing, adjusting, and balancing.
C. TAB Specialist: An entity engaged to perform TAB Work.

1.3 INFORMATIONAL SUBMITTALS

B. Certified TAB reports.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB.
   2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB as a TAB technician.
B. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
C. TAB Report Forms: Use standard TAB contractor's forms approved by Owner and Commissioning Authority.
D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems’ output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA’s "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
   1. Permanent electrical-power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
   1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section “HVAC Insulation.”

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems’ “as-built” duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section “Metal Ducts.”

M. Install clean air filters.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
   2. Measure fan static pressures as follows to determine actual static pressure:
      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Report the cleanliness status of filters and the time static pressures are measured.
   4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
   a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.
C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
   a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
3.9 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.10 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.11 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

3.12 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each refrigerant coil:
1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.14 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.15 TOLERANCES

A. Set HVAC system’s air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.16 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in “Examination” Article, prepare a report on the adequacy of design for systems’ balancing devices. Recommend changes and additions to systems’ balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers’ test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB contractor.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer’s name and address.
   7. Contractor’s name and address.
   9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
      a. Settings for outdoor-, return-, and exhaust-air dampers.
      b. Conditions of filters.
      c. Cooling coil, wet- and dry-bulb conditions.
      d. Face and bypass damper settings at coils.
      e. Fan drive settings including settings and percentage of maximum pitch diameter.
      f. Inlet vane settings for variable-air-volume systems.
      g. Settings for supply-air, static-pressure controller.
      h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outdoor, supply, return, and exhaust airflows.
   2. Water and steam flow rates.
   3. Duct, outlet, and inlet sizes.
   4. Pipe and valve sizes and locations.
   5. Terminal units.
3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 230593
SECTION 230713 - DUCT 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. Related Sections:
   1. Section 233113 "Metal Ducts" for ductwork with lining.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets or covering.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
   3. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

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

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 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 sizes and locations of supports, hangers, and insulation shields.

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

1.8 SCHEDULING

A. Schedule insulation application after any required ductwork pressure testing is complete. Insulation application may begin on segments that have satisfactory test results.
PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Duct Insulation Schedule for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; SoftTouch Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Friendly Feel Duct Wrap.
      d. Owens Corning; SOFTR All-Service Duct Wrap.
      e. Pre-approved equal.

E. 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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Commercial Board.
      b. Johns Manville; 800 Series Spin-Glas.
      c. Knauf Insulation; Insulation Board.
      d. Owens Corning; Fiberglas 700 Series.
      e. Pre-approved equal.

2.2 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. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
   1. Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Super Firetemp M.
      b. Pabco.
      c. Pre-approved equal.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
   1. Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; FlameChek.
      b. Johns Manville; Firetemp Wrap.
      c. 3M; Fire Barrier Wrap Products.
      d. Pre-approved equal.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Subject to compliance with requirements, provide one of the following:
      a. Childers Brand; CP-127.
      b. Eagle Bridges; 225.
      c. Foster Brand; 85-60/85-70.
      d. Mon-Eco Industries, Inc.; 22-25.
      e. Pre-approved equal.
   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand; CP-82.
      b. Eagle Bridges; 225.
      c. Foster Brand; 85-50.
      d. Mon-Eco Industries, Inc.; 22-25.
      e. Pre-approved equal.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Subject to compliance with requirements, provide one of the following:
      a. Foster Brand; 30-80/30-90.
      b. Vimasco Corporation; 749.
      c. Pre-approved equal.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand; CP-50 AHV2.
      b. Foster Brand; 30-36.
      c. Vimasco Corporation; 713 and 714.
      d. Pre-approved equal.
   3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
   4. Service Temperature Range: 0 to plus 180 deg F.

2.6 SEALANTS

A. FSK Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand; CP-76.
      b. Eagle Bridges; 405.
      c. Foster Brand; 95-44.
      d. Mon-Eco Industries, Inc.; 44-05.
      e. Pre-approved equal.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 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.

2.9 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI; 491 AWF FSK.
   b. Avery Dennison Corporation; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   e. Pre-approved equal.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Insulation Pins and Hangers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Keep insulation materials dry during application and finishing.

E. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

F. Install insulation with least number of joints practical.

G. Where vapor barrier is indicated, seal joints, seams, and penetrations. No penetration in insulation is permitted at hangers, supports, and other projections.
   1. Install insulation continuously through hangers and supports.
   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.

H. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

I. 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.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive sealing tape.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

J. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

L. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Firestopping materials and fire-resistive joint sealers applicable for the installation.

C. Insulation Installation at Floor Penetrations:
   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Seal penetrations through fire-rated assemblies.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket or Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides or bottom 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 or bottom with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches minimum 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, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION
   A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
   B. Insulate duct access panels and doors to achieve same fire rating as duct.
   C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL
   A. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION 230713
SECTION 230719 - HVAC PIPING 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 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
   B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
      1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
      2. Detail insulation application at pipe expansion joints for each type of insulation.
      3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
      4. Detail removable insulation at piping specialties.
      5. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For qualified Installer.

1.4 QUALITY ASSURANCE
   A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
   B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
      1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
      2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

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

1.6 COORDINATION
   A. Coordinate sizes and locations of supports, hangers, and insulation shields.
   B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
   C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING
   A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Piping Insulation Schedule.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells.
   1. Products: Subject to compliance with requirements, provide the following or equivalent:
      a. Pittsburgh Corning Corporation; Foamglas.
      b. Pre-approved equal.

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aerocel.
      b. AP Armaflex.
      c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
      d. Pre-approved equal.

F. 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 I or Type II.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.
      b. Johns Manville.
      c. Owens Corning.
      d. Pre-approved equal.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fibrex Insulations Inc.; Coreplus 1200.
      b. Johns Manville; Micro-Lok.
      c. Knauf Insulation; 1000-Degree Pipe Insulation.
      d. Owens Corning; Fiberglas Pipe Insulation.
      e. Pre-approved equal.

   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 "Factory-Applied Jackets" Article.

   3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS


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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aeroseal.
      b. Armacell LLC; Armaflex 520 Adhesive.
      c. Foster Brand; 85-75.
      d. K-Flex USA; R-373 Contact Adhesive.
2. Pre-approved equal.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand; CP-127.
   b. Eagle Bridges; 225.
   c. Foster Brand; 85-60/85-70.
   d. Pre-approved equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand; CP-82.
   b. Eagle Bridges; 225.
   c. Foster Brand; 85-50.
   d. Pre-approved equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 739, Dow Silicone.
   d. Speedline Corporation; Polyco VP Adhesive.
   e. Pre-approved equal.

2. For indoor applications, adhesive shall have a VOC content of 50 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; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Foster Brand; 30-80/30-90.
   b. Vimasco Corporation; 749.
   c. Pre-approved equal.

   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand; CP-50 AHV2.
   b. Foster Brand; 30-36.
   c. Vimasco Corporation; 713 and 714.
   d. Pre-approved equal.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.

4. Service Temperature Range: 0 to plus 180 deg F.

2.6 SEALANTS
A. ASJ Flashing 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.
   5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.8 FIELD-APPLIED JACKETS
A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules. Use the following shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, traps and mechanical joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
      e. Pre-approved equal.
   2. Adhesive: As recommended by jacket material manufacturer.
C. Metal Jacket:
      a. Corrugated, 0.024 inch thick.
      b. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.
         8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES
A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI; 428 AWF ASJ.
      b. Avery Dennison Corporation, Fasson 0836.
      c. Compac Corporation; 104 and 105.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
      e. Pre-approved equal.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.10 SECUREMENTS

A. Bands:
   1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at bottom of horizontal runs.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints and seams. No penetration of insulation at hangers or supports is allowed. Seal anchors, guides 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
   4. On hot services it is permissible to staple laps with outward clinching staples along edge at 4 inches o.c.
      a. For below-ambient services, no staples are allowed.
   5. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Install with firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

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-retarder 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. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as 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. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.

6. For below-ambient services, provide a design that maintains vapor barrier.

7. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

8. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

9. 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.

10. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Install insulation as inserts at pipe hangers and supports.

1. Insulation shall be the same thickness as the adjoining insulation.

2. Provide factory applied jacket the same material as the adjoining insulation.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install 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 PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. 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.

B. 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 FIELD QUALITY CONTROL

A. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION 230719
SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 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.

1.2 SUBMITTALS

A. Product Data: For each control device indicated.

B. Shop Drawings:
   1. Schematic flow diagrams.
   2. Power, signal, and control wiring diagrams.
   3. Details of control panel faces.
   4. Valve schedule.
   5. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
   6. Control System Software: Schematic diagrams, written descriptions, and points list.

C. Software and firmware operational documentation.

D. Field quality-control test reports.

E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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 CONTROL SYSTEM

A. Schneider Electric by C&C Group.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

D. All point of user interface shall be on standard PC's that do not require the purchase of special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PC’s will be a standard web browser.

E. The BMS shall be a web-based application with microprocessor-based interoperable BACnet or LonWorks controllers in accordance with the ANSI/ASHRAE 135-2004 and most recent addendums. The system supplier must provide a PICS document showing the installed systems compliance level to the ANSI/ASHRAE Standard
135-2004. The BMS system shall communicate using the BACnet or LonWorks "open" protocol at both the supervisor and device level.

F. Integration of standalone microprocessors into the BMS shall be provided by either hardware points or as part of the packaged equipment control. Acceptable protocols to be provided for integration are:
1. BACnet IP
2. BACnet Ethernet
3. BACnet MSTP
4. BACnet ARCnet
5. Modbus RTU

G. BMS points in addition to and including those outlined herein or on the drawings shall be provided:
1. Temperatures after each coil shall be monitored.
2. Temperatures before and after any heat transfer occurrence, such as at the inlet and outlet of the energy recovery unit heat recovery wheel.
3. Supply air temperature, return air temperature, mixed air temperature and space temperature shall be monitored for each unit.
4. Digital status for each piece of controlled equipment shall be monitored.
5. For each physical point provide a document which, at a minimum, shall indicate the following:
   A. User point identification name
   B. Logical point name
   C. Alarmable (yes or no)
   D. Point description
   E. BMS panel ID
   F. Fail position (open/closed, on/off)
   G. Digital or Analog
   H. Analog control range (temperature, pressure, etc.)
   I. Analog input/output range (Volts, mA, psi, etc.)
   J. Analog high limit alarm
   K. Analog low limit alarm
   L. For each virtual point provide a document which, at a minimum, shall indicate the following: User point identification name, Logical point name, Point function and use.

6. All input points shall be alarmed. All alarms shall allow recognition, management and remote alarming.

H. The system shall be capable of supporting an unlimited number of clients using a standard web browser such as Internet Explorer® or Mozilla Firefox®. Systems requiring additional software (to enable a standard web browser) to be resident on the client machine, or manufacturer-specific browsers shall not be acceptable.

2.3 DDC EQUIPMENT

A. Operator Workstation: PC-based microcomputer with minimum configuration as follows:
1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Pentium 4, 2.0 GHz.
3. Random-Access Memory: 512MB.
4. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64-MB video memory, with TV out.
7. Floppy-Disk Drive: 1.44 MB.
8. Hard-Disk Drive: 80 GB.
9. CD-ROM Read/Write Drive: 48x24x48.
10. Mouse: Three button, optical.
12. Operating System: Microsoft Windows XP Professional with high-speed Internet access.
13. Printer: Color, ink-jet type as follows:
   A. Print Head: 4800 x 1200 dpi optimized color resolution.
   B. Paper Handling: Minimum of 100 sheets.
   C. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.
   D. Application Software.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   A. Global communications.
   B. Discrete/digital, analog, and pulse I/O.
   C. Monitoring, controlling, or addressing data points.
   D. Software applications, scheduling, and alarm processing.
   E. Testing and developing control algorithms without disrupting field hardware and controlled environment.

C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
   1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
   2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
      A. Global communications.
      B. Discrete/digital, analog, and pulse I/O.
      C. Monitoring, controlling, or addressing data points.
   3. Local operator interface provides for download from or upload to operator workstation.

D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
   1. Binary Inputs: Allow monitoring of on-off signals without external power.
   2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
   3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
   4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
   5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
   7. Universal I/Os: Provide software selectable binary or analog outputs.

E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
   1. Output ripple of 5.0 mV maximum peak to peak.
   2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
   3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
   1. Minimum dielectric strength of 1000 V.
   3. Minimum transverse-mode noise attenuation of 65 dB.
   4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
   1. Configuration: Diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
   2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
   3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.5 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
   1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.6 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:
   1. Accuracy: Plus or minus 0.5 deg F at calibration point.
   2. Wire: Twisted, shielded-pair cable.
   3. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
   4. Averaging Elements in Ducts: 36 inches long, flexible, 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
   5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
   6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
      A. Set-Point Adjustment: Exposed.
      B. Set-Point Indication: Concealed.
      C. Thermometer: Concealed.
      D. Color: color selection from manufacturer's full range.
      E. Orientation: Vertical.
   7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. Pressure Transmitters/Transducers:
   1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
      A. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
      B. Output: 4 to 20 mA.
      C. Building Static-Pressure Range: 0- to 0.25-inch wg.
      D. Duct Static-Pressure Range: 0- to 5-inch wg.
   2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
   3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
   4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
   5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

2.7 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.8 THERMOSTATS

A. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
   1. Automatic switching from heating to cooling.
   2. Preferential rate control to minimize overshoot and deviation from set point.
   3. Set up for four separate temperatures per day.
   4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
   5. Short-cycle protection.
   6. Programming based on weekday, Saturday, and Sunday.
   7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
   8. Battery replacement without program loss.
   9. Thermostat display features include the following:
      A. Time of day.
      B. Actual room temperature.
      C. Programmed temperature.
      D. Programmed time.
      E. Duration of timed override.
      F. Day of week.
      G. System mode indications include "heating," "off," "fan auto," and "fan on."

B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
   1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.

D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
   1. Bulbs in water lines with separate wells of same material as bulb.
   2. Bulbs in air ducts with flanges and shields.
   3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
   4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
   5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
   6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

E. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:
2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.

F. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
   1. Set-Point Adjustment: Exposed.
   2. Set-Point Indication: Concealed.
   3. Thermometer: Concealed.
   4. Color: Color selection from manufacturer's full range.
   5. Orientation: Vertical.

G. Room thermostat accessories include the following:
   1. Insulating Bases: For thermostats located on exterior walls.
   2. Thermostat Guards: Metal wire, tamperproof.
   3. Adjusting Key: As required for calibration and cover screws.
   4. Set-Point Adjustment: 1/2-inch- diameter, adjustment knob.

H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

J. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
   2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

K. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
   2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

L. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.9 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
   1. Comply with requirements in Division 15 Section "Motors."
   2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
   3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
   5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
   2. Dampers: Size for running torque calculated as follows:
      A. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
      B. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
      C. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
      D. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
      E. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
F. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.


4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.


7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

9. Temperature Rating: Minus 22 to plus 122 deg F.


2.10 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back seating capacity repackable under pressure.

2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

   A. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.

   B. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.

4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:

   A. Two Position: Line size.

   B. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.

   C. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

2.11 DAMPERS

A. Dampers: AMCA-rated, parallel-blade design; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 6 inches and length of 48 inches.

1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: From minus 40 to plus 200 deg F.

3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.12 CONTROL CABLE

A. All exposed cable and cable installed above in accessible ceilings shall be in conduit. Plenum rated cable is acceptable for installation above accessible ceilings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

B. Install guards on thermostats in the following locations:
   1. Where indicated.

C. Install automatic dampers according to Division 15 Section "Duct Accessories."

D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

E. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."

F. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."

G. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."

H. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. All electrical control wiring and power wiring to control panels shall be the responsibility of the controls contractor.

B. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."

C. Install building wire and cable according to Division 16 Section "Conductors and Cables."

D. Install signal and communication cable as described below:
   1. Install exposed cable in raceway.
   2. Install concealed cable in raceway.
   3. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
   6. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

E. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

F. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

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, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
   2. Test and adjust controls and safeties.
   3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
   4. Test each point through its full operating range to verify that safety and operating control set points are as required.
   5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
   6. Test each system for compliance with sequence of operation.
   7. Test software and hardware interlocks.
C. DDC Verification:
   1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
   2. Check instruments for proper location and accessibility.
   3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
   4. Check instrument tubing for proper fittings, slope, material, and support.
   5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
   6. Check temperature instruments and material and length of sensing elements.
   7. Check control valves. Verify that they are in correct direction.
   8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
   9. Check DDC system as follows:
      A. Verify that DDC controller power supply is from emergency power supply, if applicable.
      B. Verify that wires at control panels are tagged with their service designation and approved tagging system.
      C. Verify that spare I/O capacity has been provided.
      D. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 CONTROL AND MONITORING POINTS

A. All systems not included below:

B. 1. Refer to Sequence of Operation on Drawings.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative for minimum 24 hours of on-site training (six 4-hour sessions) to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 230900
SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.
   6. Concrete bases.

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.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
   2. Service Regulators: 100 psig minimum unless otherwise indicated.
   3. Minimum Operating Pressure of Service Meter: 5 psig.

B. Natural-Gas System Pressure within Buildings: 2.0 psig or less.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Corrugated, stainless-steel tubing with associated components.
   3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   4. Pressure regulators. Indicate pressure ratings and capacities.
   5. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
   1. Shop Drawing Scale: 1/4 inch per foot.
   2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.
C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Welding certificates.

E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.10 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
   1. Notify Construction Manager no fewer than two days in advance of proposed interruption of natural-gas service.
   2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.
1.11 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
   5. Mechanical Couplings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Dresser Piping Specialties; Division of Dresser, Inc.
         2) Smith-Blair, Inc.
         3) Pre-approved equal.
      b. Stainless-steel flanges and tube with epoxy finish.
      c. Buna-nitrile seals.
      d. Stainless-steel bolts, washers, and nuts.
      e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
      f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. Appliance Flexible Connectors:
   4. Corrugated stainless-steel tubing with polymer coating.
   5. Operating-Pressure Rating: 0.5 psig.
   8. Maximum Length: 72 inches

C. Quick-Disconnect Devices: Comply with ANSI Z21.41.
   1. Copper-alloy convenience outlet and matching plug connector.
   2. Nitrile seals.
   3. Hand operated with automatic shutoff when disconnected.
   4. For indoor or outdoor applications.
   5. Adjustable, retractable restraining cable.

D. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
   4. OWP Rating: 125 psig.

E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
2.2 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.


C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.3 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig.
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BrassCraft Manufacturing Company; a Masco company.
      c. Lyall, R. W. & Company, Inc.
      e. Perfection Corporation; a subsidiary of American Meter Company.
      f. Pre-approved equal.
   3. Ball: Chrome-plated bronze.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Threaded-body packnut design with adjustable-stem packing.
   8. CWP Rating: 600 psig.
   9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lee Brass Company.
      c. Pre-approved equal.
   5. Operator: Square head or lug type with tamperproof feature where indicated.
   6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flowserve.
   b. Homestead Valve; a division of Olson Technologies, Inc.
   d. Milliken Valve Company.
   e. Mueller Co.; Gas Products Div.
   g. Pre-approved equal.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 MOTORIZED GAS VALVES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ASCO Power Technologies, LP; Division of Emerson.
   b. Dungs, Karl, Inc.
   c. Eaton Corporation; Controls Div.
   d. Eclipse Combustion, Inc.
   e. Honeywell International Inc.
   f. Johnson Controls.
   g. Pre-approved equal.
2. Body: Brass or aluminum.
5. Normally closed.
7. Electrical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ASCO Power Technologies, LP; Division of Emerson.
   b. Dungs, Karl, Inc.
   c. Eclipse Combustion, Inc.
   d. Goyen Valve Corp.; Tyco Environmental Systems.
   e. Magnotrol Valve Corporation.
   f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
   g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   h. Pre-approved equal.
2. Pilot operated.
3. Body: Brass or aluminum.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
2.5 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Actaris.
   b. American Meter Company.
   c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   d. Invensys.
   e. Richards Industries; Jordan Valve Div.
   f. Pre-approved equal.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Actaris.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   e. Invensys.
   f. Maxitrol Company.
   g. Richards Industries; Jordan Valve Div.
   h. Pre-approved equal.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Canadian Meter Company Inc.
   b. Eaton Corporation; Controls Div.
   c. Harper Wyman Co.
   d. Maxitrol Company.
   e. SCP, Inc.
   f. Pre-approved equal.
5. Seat Disc: Nitrile rubber.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Central Plastics Company.
   d. Jomar International Ltd.
   e. Matco-Norca, Inc.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   h. Wilkins; a Zurn company.
   i. Pre-approved equal.
2. Description:
   b. Pressure Rating: 150 psig.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Central Plastics Company.
   c. Matco-Norca, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.
   f. Pre-approved equal.
2. Description:
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 150 psig.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
   e. Pre-approved equal.
2. Description:
   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig.
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

2.7 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of
utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
   1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:
   1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
   3. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

F. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.
H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
I. Install piping free of sags and bends.
J. Install fittings for changes in direction and branch connections.
K. Verify final equipment locations for roughing-in.
L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
   1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
   2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
   3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
   4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
      a. Exception: Tubing passing through partitions or walls does not require striker barriers.
   5. Prohibited Locations:
      a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
      b. Do not install natural-gas piping in solid walls or partitions.
Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
R. Connect branch piping from top or side of horizontal piping.
S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
T. Do not use natural-gas piping as grounding electrode.
U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."
W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
   2. Bevel plain ends of steel pipe.
   3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
   5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      c. Topcoat: Exterior alkyd enamel (semigloss).
      d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
      c. Topcoat: Interior latex (low sheen).
      d. Color: Gray.
   2. Alkyd System: MPI INT 5.1E.
      c. Topcoat: Interior alkyd (eggshell).
      d. Color: Gray.
D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.

1. Construct concrete bases a minimum of 4 inches and a maximum of 6 inches high, and not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.15 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas pipingshall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

B. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility’s gas mains and listed by an NRTL.

3.18 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, lubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123
SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant:
   1. Suction Lines for Air-Conditioning Applications: 185 psig
   2. Suction Lines for Heat-Pump Applications: 325 psig
   3. Hot-Gas and Liquid Lines: 325 psig

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
   1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE


B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch long assembly.
4. Pressure Rating: Factory test at minimum 500 psig
5. Maximum Operating Temperature: 250 deg F

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Operator: Rising stem and hand wheel.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig
7. Maximum Operating Temperature: 275 deg F

B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig
8. Maximum Operating Temperature: 275 deg F

C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig
8. Working Pressure Rating: 500 psig
9. Maximum Operating Temperature: 275 deg F

D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24V ac coil.
6. Working Pressure Rating: 400 psig
7. Maximum Operating Temperature: 240 deg F

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig
6. Maximum Operating Temperature: 240 deg F

G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F
6. Superheat: Adjustable
7. End Connections: Socket, flare, or threaded union.
8. Working Pressure Rating: 700 psig

H. Straight-Type Strainers:
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig
5. Maximum Operating Temperature: 275 deg F

I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig
6. Maximum Operating Temperature: 275 deg F

J. Moisture/Liquid Indicators:
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig
7. Maximum Operating Temperature: 240 deg F

K. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina
4. End Connections: Socket
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig
7. Working Pressure Rating: 500 psig
8. Maximum Operating Temperature: 240 deg F

L. Permanent Filter Dryers: Comply with ARI 730.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket
7. Maximum Pressure Loss: 2 psig
8. Working Pressure Rating: 500 psig
9. Maximum Operating Temperature: 240 deg F

M. Liquid Accumulators: Comply with ARI 495.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig
4. Maximum Operating Temperature: 275 deg F
PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.

B. Hot-Gas and Liquid Lines, Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR drawn-temper tubing and wrought-copper fittings with soldered joints.

D. Safety-Relief-Valve Discharge Piping:
   1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
   2. L drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at strainers if they are not an integral part of strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install flexible connectors at compressors.
3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
3.4 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
   2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 1/2: Maximum span, 60 inches minimum rod size, 1/4 inch (6.4 mm).
   2. NPS 5/8: Maximum span, 60 inches minimum rod size, 1/4 inch
   3. NPS 1: Maximum span, 72 inches minimum rod size, 1/4 inch
   4. NPS 1-1/4: Maximum span, 96 inches minimum rod size, 3/8 inch.
   5. NPS 1-1/2: Maximum span, 96 inches minimum rod size, 3/8 inch

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Comply with ASME B31.5, Chapter VI.
   2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
      a. Fill system with nitrogen to the required test pressure.
      b. System shall maintain test pressure at the manifold gage throughout duration of test.
      c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
      d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:
   1. Install core in filter dryers after leak test but before evacuation.
   2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
   3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
   4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300
SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Low pressure rectangular ducts and fittings.
   2. Low pressure ductwork.
   3. Medium pressure ductwork.
   4. Single-wall round and flat-oval ducts and fittings.
   5. Single-wall round ductwork.
   6. Double-wall round and flat-oval ducts and fittings.
   7. Double-wall round ductwork.
   8. Sheet metal materials.
   10. Sealants and gaskets.
   11. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of bottom of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. LEED Submittals:
   1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
   2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
   3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
   4. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
5. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

6. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Duct materials other than the above is specified in the particular ductwork description.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be as indicated in the Duct Schedule.

E. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

2.2 LOW PRESSURE RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995" based on 2" w.g. static-pressure class, Table 1-5.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995,” Figure 1-5, “Rectangular Duct/Longitudinal Seams,” for 2” w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995.”


1. All elbows or offsets in rectangular ductwork under positive pressure shall contain turning vanes. Turning vanes in low pressure ductwork shall be single wall.

2. All rectangular branch takeoffs in supply ductwork shall be of the 45 deg. entry design with a manual damper. Round take-offs in supply ductwork shall use rectangular to round transition with 45 degree entry design and a manual damper in the round, Sheet Metal Connectors H.E.T. (Hi-Efficiency Take-Off) or equal.

2.3 MEDIUM PRESSURE RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995” based on 4” w.g. static-pressure class, Table 1-5.

B. Transverse Joints: Select joint types and fabricate according to SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible,” Figure 2-1, “Rectangular Duct/Transverse Joints,” for 4” w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible.”

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible,” Figure 2-2, “Rectangular Duct/Longitudinal Seams,” for 4” w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995.”


1. All elbows or offsets in rectangular ductwork that exceed 33 degrees shall contain turning vanes. Turning vanes in medium pressure ductwork shall be double wall.

2. Rectangular branch take-offs shall be of the 45 deg. entry design as detailed in SMACNA “HVAC Duct Construction Standards, Second Edition-1995,” Figure 2-6. Round take-offs or taps shall be of the conical or bellmouth design or 45 deg. rectangular to round entry design with sealer and mechanical fasteners used at tap connection. Round take-offs larger than duct height shall be of the 45 deg. entry design with a rectangular to round branch connections. The rectangular area shall be a minimum of 1-1/2 times the branch area. Sealer shall be used at the branch connection.

2.4 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Low pressure round ducts shall be constructed per SMACNA HVAC Construction Standards, Table 3-2, 2” w.g. (pos.), Second Edition, 1995 with Addendum No. 1, for galvanized steel with grooved longitudinal seam and sleeved type transverse joint, pipe riveted. Hangers shall be 2” band, attached at duct joints with draw bands. Spiral duct and fittings per paragraph below may be used as an option.

B. Round ducts in medium pressure systems and ahead of terminal boxes shall be of the continuous weld or continuous lock seam construction from ASTM A-527-67 galvanized steel. All round fittings shall be manufactured from galvanized steel with continuous welds or locked seams. Gasketed self-sealing spiral duct and fittings installed in accordance with manufacturer’s instructions may be used. All round ducts and fittings shall be equal constructed to the gauges called for in SMACNA HVAC Round Duct Construction Standards, Table 3-2, for spiral lock seam duct, 10” w.g., Second Edition, 1995 with Addendum No. 1.

C. All exposed round ducts regardless of system pressure, shall be constructed as described in paragraph B above.

D. All round ducts shall be sealed per SMACNA seal classification “B” requirements.
2.5 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
      e. Pre-approved equal.
   2. Minimum Thermal Conductivity:
      a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Shop Application of Duct Liner: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. 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.
   6. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
      a. Fan discharges.
      b. Intervals of lined duct preceding unlined duct.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.
   6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services’ "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.


D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a minimum clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

D. All elbow or offsets exceeding 33 degrees shall utilize sweep/radius elbows with a centerline radius equal to or greater than the duct width.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR DISHWASHER EXHAUST DUCT

A. Solder ducts water tight. Install stainless steel damper with locking quadrant in the drops to the dishwasher. Ductwork shall be sloped to drain to the connection at the dirty dish end of the dishwasher.

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in ductwork schedule on drawings.

3.6 HANGER AND SUPPORT INSTALLATION


B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible,” Table 5-1, “Rectangular Duct Hangers Minimum Size,” and Table 5-2, “Minimum Hanger Sizes for Round Duct,” for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."


3.8 PAINTING

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

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

3.10 DUCT CLEANING

A. Clean duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.
   1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
   2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind away from air intakes and other points of entry into building.
D. Clean the following components by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
   7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
   4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
   5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
   6. Provide drainage and cleanup for wash-down procedures.
   7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer’s written instructions after removal of surface deposits and debris.

3.11 START UP

A. Air Balance: Comply with requirements in “Testing, Adjusting, and Balancing for HVAC.”

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows.

B. Refer to ductwork schedule on drawings.

END OF SECTION 233113
SECTION 233300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Backdraft dampers.
   2. Volume dampers.
   3. Fire dampers.
   4. Smoke dampers.
   5. Combination fire and smoke dampers.
   6. Turning vanes.
   7. Duct-mounting access doors.
   8. Flexible connectors.
  10. Duct accessory hardware.
  11. Duct silencers.

B. See "Fire Alarm" for duct-mounting fire and smoke detectors.

C. See Division 23 Section "HVAC Instrumentation and Controls" for electric and pneumatic damper actuators.

1.2 SUBMITTALS

A. Product Data: For the following:
   1. Backdraft dampers.
   2. Volume dampers.
   3. Fire dampers.
   4. Smoke dampers.
   5. Combination fire and smoke dampers.
   6. Turning vanes.
   7. Duct-mounting access doors.
   8. Flexible connectors.
  10. Duct silencers.

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. Special fittings.
   3. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors.

1.3 QUALITY ASSURANCE


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 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. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.


F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance, Inc.
   2. American Warming and Ventilating.
   3. CESCO Products.
   4. Duro Dyne Corp.
   5. Greenheck.
   7. Prefco Products, Inc.
   8. Ruskin Company.
   10. Pre-approved equal.

B. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.052-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

D. Blades: 0.050-inch-thick aluminum sheet.

E. Blade Seals: Neoprene.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance, Inc.
   2. American Warming and Ventilating.
   3. Flexmaster U.S.A., Inc.
   5. METALAIRE, Inc.
   6. Nailor Industries Inc.
   7. Penn Ventilation Company, Inc.
   8. Ruskin Company.
10. Greenheck Fan Corporation
11. Pre-approved equal.

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.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
   1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, 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: 0.064-inch-thick, galvanized sheet steel.
   5. Tie Bars and Brackets: Galvanized steel.

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.

2.5 FIRE DAMPERS

A. Manufacturers:
   1. Air Balance, Inc.
   2. CESCO Products.
   5. METALAIRE, Inc.
   6. Nailor Industries Inc.
   7. Penn Ventilation Company, Inc.
   8. Prefco Products, Inc.
   12. Pre-approved equal.

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: 1-1/2 hours for dampers in walls rated 2-hours or less. 3 hour rating for dampers in walls rated greater than 2-hours.

D. Frame: Low pressure applications (2” wg and less): curtain type with blades inside airstream; for ductwork constructed in higher pressure applications (above 2” wg): curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 0.138 inch thick and of length to suit application.
   2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
I. Fusible Links: Replaceable, 165 deg F rated.

2.6 SMOKE OR COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:
   1. Air Balance, Inc.
   2. CESCO Products.
   4. Nailor Industries Inc.
   5. Penn Ventilation Company, Inc.
   6. Ruskin Company.
   7. Pre-approved equal

B. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

C. Fusible Links: Replaceable, 165 deg F rated.

D. Frame and Blades: 0.064-inch-thick, galvanized sheet steel.

E. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application.

F. Damper Motors: Modulating and two-position action.
   1. Motors: With oil-immersed and sealed gear trains.
   2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lb and breakaway torque rating of 150 in. x lb.
   3. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
   4. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lb and breakaway torque rating of 300 in. x lb.
   5. Electrical Connection: 115 V, single phase, 60 Hz.

2.7 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch-wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ductmate Industries, Inc.
      b. Duro Dyne Corp.
      c. METALAIRE, Inc.
      d. Ward Industries, Inc.
      e. Pre-approved equal.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.8 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 vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Warming and Ventilating.
      b. CESCO Products.
      c. Ductmate Industries, Inc.
      d. Flexmaster U.S.A., Inc.
e. Greenheck.
g. Nailor Industries Inc.
h. Ventfabrics, Inc.
i. Ward Industries, Inc.
j. Elgen Manufacturing
k. Pre-approved equal.
2. Frame: 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. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ductmate Industries, Inc.
      b. Flexmaster U.S.A., Inc.
      c. Pre-approved equal.
   2. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Corp.
   3. Ventfabrics, Inc.
   5. Pre-approved equal.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

2.10 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexmaster U.S.A., Inc.
   2. Thermalflex.
   4. Pre-approved equal.

B. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   3. Temperature Range: Minus 10 to plus 160 deg F.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.
2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.12 DUCT SILENCERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Industrial Acoustics Company.
   2. Vibroacoustics.
   3. Pre-approved equal.

B. General Requirements:
   1. Furnish and install “Quiet-Duct” (rectangular) silencers of the types and sizes shown on the plans and/or listed in the schedule. Silencers shall be the product of Industrial Acoustics Company. Any specification change must be submitted in writing and approved by the Architect/Engineer, in writing, at least 10 days prior to the bid due-date.

C. Materials:
   1. Outer casings of rectangular silencers shall be made of 22 gauge type #G-90 lock-former-quality galvanized steel.
   2. Interior partitions for rectangular silencers shall be not less than 26 gauge type #G-90 galvanized lock-former-quality perforated steel.
   3. Filler material shall be inorganic glass fiber of a proper density to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin- and moisture-proof.
   4. Combustion ratings for the silencer acoustic fill shall be not greater than the following when tested to ASTM E 84, NFPA Standard 255, or UL No. 723:

D. Construction:
   1. Units shall be constructed in accordance with the ASHRAE Guide recommendations for high pressure duct work. Seams shall be lock formed and mastic filled. Rectangular casing seams shall be in the corners of the silencer shell to provide maximum unit strength and rigidity. Interior partitions shall be fabricated from single-piece, margin-perforated sheets and shall have die-formed entrance and exit shapes so as to provide the maximum aerodynamic efficiency and minimum self-noise characteristics in the sound attenuator. Blunt noses or squared off partitions will not be accepted.
   2. Attachment of the interior partitions to the casing shall be by means of an interlocking track assembly. Tracks shall be solid galvanized steel and shall be welded to the outer casing. Attachment of the interior partitions to the tracks shall be such that a minimum of 4 thicknesses of metal exist at this location. The track assembly shall stiffen the exterior casing, provide a reinforced attachment detail for the interior partitions, and shall maintain a uniform airspace width along the length of the silencer for consistent aerodynamic and acoustic performance. Interior partitions shall be additionally secured to the outer casing with welded nose clips at both ends of the sound attenuator.
   3. Sound attenuating units shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge from inside to outside the casing. Airtight construction shall be provided by use of a duct sealing compound on the job-site material and labor furnished by the contractor.

E. Acoustic Performance:
   1. All silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM Specification E477-99. The test facility shall be NVLAP accredited for the ASTM E477-99 test standard. Data from a non-accredited laboratory will not be acceptable. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves and test chamber sound absorption are eliminated. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for FORWARD FLOW (air and noise in same direction) and REVERSE FLOW (air and noise in opposite directions) with airflow of at least 2000 fpm entering face velocity. Data for rectangular and tubular type silencers shall be presented for tests conducted using silencers no smaller than the following cross-sections:
      a. Rectangular, inch: 24x24, 24x30, or 24x36.
b. Tubular, inch: 12, 24, 36, and 48.

F. Aerodynamic Performance:
   1. Static pressure loss of silencers shall not exceed 0.05” wg. Airflow measurements shall be made in accordance with ASTM specification E477-99 and applicable portions of ASME, AMCA, and ADC airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented.

G. Certification:
   1. With submittals, the manufacturer shall supply certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions. Test data shall be for a standard product. All rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection upon request from the Architect/Engineer.

H. Duct Transitions:
   1. When transitions are required to adapt silencer dimensions to connecting duct work they shall be furnished by the installing contractor.

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 and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install 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. 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.

F. Provide test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.

H. 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. Downstream from volume dampers and equipment.
   3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
   4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
   5. On sides of ducts where adequate clearance is available.

I. 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.

J. Install the following sizes for duct-mounting, round access doors:
   1. One-Hand or Inspection Access: 8 inches in diameter.
   3. Head and Hand Access: 12 inches in diameter.
K. Label access doors according to Division 23 Section "HVAC System Identification."

L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

M. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

N. Connect flexible ducts to metal ducts with draw bands.

O. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300
SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceiling, wall and floor-mounted diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

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. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GRILLES, DIFFUSERS AND REGISTERS

A. See schedule on the drawings.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Krueger.
      b. Nailor Industries of Texas Inc.
      c. Price Industries.
      d. Titus.
      e. Pre-approved equal.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 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.
3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713
SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Electric Heating.
   3. Economizer outdoor- and return-air damper section.
   4. Roof curbs.

1.2 DEFINITIONS

A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

B. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

F. VVT: Variable-air volume and temperature.

1.3 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

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.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. ARI Compliance:
   1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
   2. Comply with ARI 270 for testing and rating sound performance for RTUs.
B. ASHRAE Compliance:
1. Comply with ASHRAE 15 for refrigerant system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Compressors: Manufacturer’s standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer’s standard, but not less than five years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer’s standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer’s standard, but not less than three 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. Aaon.
2. Trane.
3. Lennox.

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
1. Exterior Casing Thickness: 0.0626 inch thick.

C. Inner Casing Fabrication Requirements:
1. Inside Casing: Galvanized steel, 0.028 inch thick.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
1. Materials: ASTM C 1071, Type I.
2. Thickness: 1/2 inch.
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of galvanized-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.
1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple.
3. Pan-Top Surface Coating: Corrosion-resistant compound.
F. **Airstream Surfaces:** Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

### 2.3 FANS

A. **Belt-Driven Supply-Air Fans:** Double width, forward curved, centrifugal; with permanently lubricated, VFD rated motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. **Condenser-Coil Fan:** Propeller, mounted on shaft of permanently lubricated motor.

C. **Relief-Air Fan:** Propeller or forward curved, shaft mounted on permanently lubricated motor.

D. **Fan Motor:** Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

### 2.4 COILS

A. **Supply-Air Refrigerant Coil:**
   1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

B. **Outdoor-Air Refrigerant Coil:**
   1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

### 2.5 REFRIGERANT CIRCUIT COMPONENTS

A. **Compressor:** Hermetic, reciprocating or hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

B. **Refrigeration Specialties:**
   1. Refrigerant: R-410A.
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   5. Automatic-reset low-pressure safety switch.
   8. Brass service valves installed in compressor suction and liquid lines.

### 2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated: Minimum 90 percent arrestance, and MERV 7.

### 2.7 ELECTRIC-RESISTANCE HEATING

A. **Open Heating Elements:** Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

B. **Overtemperature Protection:** Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.

C. **Overcurrent Protection:** Manual-reset thermal cutouts, factory wired in each heater stage.

D. **Control Panel:** Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
   1. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
2. Time-delay relay.
3. Airflow proving switch.

2.8 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
   1. Damper Motor: Modulating with adjustable minimum position.
   2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. DDC Controller:
   1. Controller shall have volatile-memory backup.
   2. Safety Control Operation:
      a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
      b. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."
   3. Refer to control sequence on the Drawings.

C. Interface Requirements for HVAC Instrumentation and Control System:
   1. Interface relay for scheduled operation.
   2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
   3. Provide BACnet compatible interface for central HVAC control workstation for the following:
      a. Adjusting set points.
      b. Monitoring supply fan start, stop, and operation.
      c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
      d. Monitoring occupied and unoccupied operations.

2.11 ACCESSORIES

A. Electric heater with integral thermostat maintains minimum 50 deg F temperature in gas burner compartment.

B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Coil guards of painted, galvanized-steel wire.

E. Hail guards of galvanized steel, painted to match casing.

F. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.
2.12 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 2 inches.
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
      d. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Curb Height: 16 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:
   1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

D. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

E. Install piping adjacent to RTUs to allow service and maintenance.
   1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

F. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
   4. Install return-air duct continuously through roof structure.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:
1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.3 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

END OF SECTION 237413
SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes factory-packaged units (DOAS) with energy recovery wheels capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Prepare the following by or under the supervision of a qualified professional engineer:
      a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
      b. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For design of vibration isolation, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Unit fabrication and assembly details.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   3. Design Calculations:
      a. Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
      b. Indicate compliance with "Performance Requirements" article.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
   2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

B. Startup service reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set for each unit.
1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Five years from date of Substantial Completion.
   2. Warranty Period for Heat Exchangers: 25 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. Aaon.
   2. Trane.
   3. Lennox.

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation.

C. Cabinet Thermal Performance:
   1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
   2. Maximum Overall U-Value: 0.10 Btu/h x sq. ft. x deg F (Include effects of metal-to-metal contact and thermal bridges in the calculations.
   3. R-13 insulation.

D. Cabinet Surface Condensation:
   1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
   2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

E. Maximum Cabinet Leakage: 2 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.

F. Cabinet Deflection Performance:
   1. Walls and roof deflection shall be within 1/240 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
   2. Floor deflections shall be within 1/360 of the span considering the worst-case condition caused by the following:
      a. Service personnel.
      b. Internal components.
      c. Design working pressure defined for the walls and roof.

G. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Capacities and Characteristics: Refer to Drawings.

2.3 CABINET

A. Construction: Double wall foam injected casing.

B. Exterior Casing Material: Galvanized steel with paint finish.

C. Interior Casing Material: Galvanized steel.

E. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.

F. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
   1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

G. Roof: Standing seam or membrane; sloped to drain water.

H. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

I. Cabinet Insulation:
   1. R-13, 2” foam insulation.

J. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.
   1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
   2. Drain Connections: Threaded nipple one side of drain pan.

K. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

2.4 SUPPLY FAN

A. Plenum Fan Type: Single width, non-overloading, with backward-inclined or airfoil blades.
   1. Fan Wheel Material: Aluminum; attached directly to motor shaft.
   5. Fan Balance: Precision balance fan below 0.08 inch/st design speed with filter in.

B. Motors:
   1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 “Common Motor Requirements for HVAC Equipment.”
   2. Enclosure: Totally enclosed.
   3. Enclosure Materials: Cast iron or cast aluminum.
   4. Efficiency: Premium efficient.

C. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with spring isolators.

2.5 COOLING COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410.

B. Coil Casing Material: Manufacturer's standard material.

C. Tube Material: Copper.

D. Tube Header Material: Manufacturer's standard material.

E. Fin Material: Aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested with air underwater.

H. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

I. Reheat coil shall be fully integrated into the supply air and fan system and capable of delivering design supply air temperature.
To prevent re-hydration of condensate from evaporator coil, the evaporator coil face and the hot gas reheat coil face shall be separated a minimum of six inches.

2.6 REFRIGERATION SYSTEM


B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Scroll and digital scroll compressors (as scheduled) with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater.

D. Refrigerant: R-410A.
   1. Classified as Safety Group A1 according to ASHRAE 34.
   2. Provide unit with operating charge of refrigerant.

E. Refrigeration System Specialties:
   1. Expansion valve with replaceable thermostatic element.
   2. Refrigerant dryer.
   3. High-pressure switch.
   4. Low-pressure switch.
   5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
   6. Brass service valves installed in discharge and liquid lines.

F. Capacity Control:
   1. Single compressor with evaporator and condenser coil within the refrigerant section to provide initial pre-cooling and modulating hot gas reheat for humidity control.

G. Refrigerant condenser coils:
   2. Tube Material: Copper.
   3. Fin Material: Aluminum.
   5. Leak Test: Coils shall be leak tested with air underwater.

H. Condenser Fan Assembly:
   1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
   2. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
      b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.
      c. Enclosure Materials: Cast iron or cast aluminum.
      d. Built-in overcurrent and thermal-overload protection.
      e. Efficiency: Premium efficient.
   3. Fan Safety Guards: Steel with corrosion-resistant coating.

I. Safety Controls:
   1. Compressor motor and condenser coil fan motor low ambient lockout.
   2. Overcurrent protection for compressor motor.

2.7 ELECTRIC-RESISTANCE HEATING:

A. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

B. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
C. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.

D. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
   1. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
   2. Time-delay relay.
   3. Airflow proving switch.

2.8 HEAT WHEELS

A. Casing:
   1. Steel with standard factory-painted finish.
   2. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
   3. Casing seals on periphery of rotor and on duct divider and purge section.
   4. Support vertical rotors on grease-lubricated ball bearings having extended grease fittings or permanently lubricated bearings. Support horizontal rotors on tapered roller bearing.

B. Rotor: Aluminum segmented wheel strengthened with radial spokes, with nontoxic, noncorrosive, desiccant coating.
   1. Maximum Solid Size for Media to Pass: 4 ANGSTROM.

C. Sensible and latent recovery efficiencies must be clearly documented through a testing program conducted in accordance with ASHRAE Standard 84 and AHRI 1060. The testing must have been conducted by a qualified independent organization. The performance test reports must be provided for engineering review as part of the submittals for this project.

D. Drive: Fractional horsepower motor and gear reducer and self-adjusting multilink belt around outside of rotor.
   1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

E. Controls:
   1. Starting relay, factory mounted and wired.
   2. Variable frequency controllers, factory mounted and wired, permitting input of field connected 4-20 mA or 1-10 V control signal.
   3. Modulate wheel bypass dampers to maintain exhaust temperature above freezing and air differential temperature above set point.

2.9 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.10 FILTERS

A. Disposable Panel Filters:
   1. Comply with NFPA 90A.
   2. Factory-fabricated, viscous-coated, flat-panel type.
   3. Thickness: 2-inch.
   4. Minimum Arrestance: 80, according to ASHRAE 52.1.
   5. Minimum Merv: 8, according to ASHRAE 52.2.

B. Mounting Frames:
   1. Panel filters arranged for angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.11 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Wiring: Numbered and color-coded to match wiring diagram.

C. Wiring Location: Install factory wiring outside an enclosure in a raceway.

D. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
   1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
   2. NEMA KS 1, heavy-duty, nonfusible switch.
   3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

E. Factory-Mounted, Overcurrent-Protection Service: For each motor.

F. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

G. Controls: Factory wire unit-mounted controls.

H. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.

I. Control Relays: Auxiliary and adjustable time-delay relays.

2.12 CONTROLS

A. Unit to be provided with terminal strip for control by controls contractor.

B. Control Wiring: Factory wire connection for controls' power supply.

C. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions. All devices to be factory mounted.

D. Unit-Mounted Status Screen:
   1. Cooling/Off/Heating Controls: Control operational mode.
   2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
   3. Status:
      a. Filter condition.
      b. Fan status.
      c. Cooling mode.
      d. Dehumidification mode.
      e. Economizer mode.
      f. Energy wheel mode.
      g. Heating mode.
      h. Smoke alarm.
      i. General alarm.
      j. Damper position (OA, RA, RA Bypass, Wheel Bypass).
      k. Supply air temperature.
      l. Space temperature (where applicable).

E. Control Dampers:
   1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
   2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
6. Damper Frame Material: Extruded aluminum, galvanized steel, or stainless steel.
7. Blade Type: Single-thickness metal reinforced with multiple V-grooves or hollow-shaped airfoil.
8. Blade Material: Extruded aluminum, galvanized steel, or stainless steel.

F. Damper Operators:
1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 90 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words “OPEN” and “CLOSED,” or similar identification, at travel limits.
6. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.

G. Refrigeration System Controls:
1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb (adj.) of dry air or outdoor-air temperature is less than 60 deg F.

H. Furnace Controls:
1. Factory-mounted sensor in supply outlet with sensor adjustment located in control panel to modulate gas furnace burner to maintain space temperature.
2. Electromechanical or Electronic Burner Control: 10 to 100 percent modulation of the firing rate; 10 to 100 percent with dual-furnace units.

I. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display unit status and alarms.
1. Hardwired Points:
   b. Control: On-off operation, supply temperature set-point adjustment.
   c. ASHRAE 135 (BACnet) communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.
      1) Filter condition.
      2) Fan status.
      3) Cooling mode.
      4) Dehumidification mode.
      5) Economizer mode.
      6) Energy wheel mode.
      7) Heating mode.
      8) Smoke alarm.
      9) General alarm.
     10) Damper position (OA, RA, RA Bypass, Wheel Bypass).
     11) Supply air temperature.
     12) Space temperature (where applicable).
2.13 ACCESSORIES

A. Duplex Receptacle: Factory mounted in unit supply-fan section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

2.14 ROOF CURBS

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 1 inch.
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
      d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 16 inches.

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 piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to “The NRCA Roofing Manual.”
   1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
   2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 “Roof Accessories.”
   3. Coordinate size, location, and installation of unit manufacturer’s roof curbs and equipment supports with roof Installer.

C. Restrained Curb Support: Install restrained vibration isolation roof-curb rails on roof structure according to “The NRCA Roofing Manual.”

D. Equipment Mounting:
   1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 “Vibration and Seismic Controls for HVAC.”
   2. Comply with requirements for vibration isolation devices specified in Section 230548.13 “Vibration Controls for HVAC.”

E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

G. Install separate devices furnished by manufacturer and not factory installed.

H. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

I. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Gas Piping Connections:
   1. Comply with requirements in Section 2311.23 "Facility Natural-Gas Piping."
   2. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
   3. Install AGA-approved flexible connectors.

C. Duct Connections:
   1. Comply with requirements in Section 2331.13 "Metal Ducts."
   2. Drawings indicate the general arrangement of ducts.
   3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 2333.00 "Air Duct Accessories."

D. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
   1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Inspect units for visible damage to furnace combustion chamber.
   3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
      a. Measure gas pressure at manifold.
      b. Measure combustion-air temperature at inlet to combustion chamber.
      c. Measure flue-gas temperature at furnace discharge.
      e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
   4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
      a. High-limit heat exchanger.
      b. Alarms.
   5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
   6. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
      a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
      b. Cooling coil entering-air, dry- and wet-bulb temperatures.
      c. Condenser coil entering-air dry-bulb temperature.
      d. Condenser coil leaving-air dry-bulb temperature.
   7. Simulate maximum cooling demand and inspect the following:
      a. Compressor refrigerant suction and hot-gas pressures.
      b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
   8. Inspect casing insulation for integrity, moisture content, and adhesion.
   9. Verify that clearances have been provided for servicing.
   10. Verify that controls are connected and operable.
   11. Verify that filters are installed.
   12. Clean coils and inspect for construction debris.
   13. Clean furnace flue and inspect for construction debris.
   15. Purge gas line.
   16. Inspect and adjust vibration isolators and seismic restraints.
   17. Verify bearing lubrication.
18. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
19. Adjust fan belts to proper alignment and tension.
20. Start unit.
21. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
22. Operate unit for run-in period.
23. Calibrate controls.
25. Inspect outdoor-air dampers for proper stroke.
26. Verify operational sequence of controls.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433
SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Compressor: One year from date of Substantial Completion.
      b. For Parts: One year from date of Substantial Completion.
      c. For Labor: One year 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. Daikin.
   2. LG.
   3. Mitsubishi.
   4. SANYO.
   5. Trane
   6. Pre-approved equal.
2.2 INDOOR UNITS 5 TONS OR LESS

A. Concealed Evaporator-Fan Components:
   1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
   2. Insulation: Faced, glass-fiber duct liner.
   4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch; leak tested to 300 psig underwater; with a two-position control valve.
   6. Fan: Forward curved, double-width wheel of galvanized steel; directly connected to motor.
   7. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
      b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
      c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
   8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   10. Condensate Drain Pans:
      a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
         1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1
         2) Depth: A minimum of 2 inches deep.
      b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
      c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
      1) Minimum Connection Size: NPS 1
      d. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Wall-Mounted, Evaporator-Fan Components:
   1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
   2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
   5. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
      b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
      c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
      d. Controller, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
      e. Mount unit-mounted disconnect switches on exterior.
      f. ASHRAE compliance in "Airstream Surfaces" Subparagraph below may be required to comply with Project requirements or authorities having jurisdiction. Retain first subparagraph to comply with LEED Prerequisite IEQ 1.
   6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
   7. Condensate Drain Pans:
      a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
         1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1
         2) Depth: A minimum of 1"
c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
   1) Minimum Connection Size: NPS 1

d. Pan-Top Surface Coating: Asphaltic waterproofing compound.

8. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 1 inch

2.3 OUTDOOR UNITS 5 TONS OR LESS

A. Air-Cooled, Compressor-Condenser Components:
   1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
   2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
      a. Compressor Type: Scroll.
      b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
      c. Refrigerant Charge: R-410A
      d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
   4. Fan: Aluminum-propeller type, directly connected to motor.
   5. Motor: Permanently lubricated, with integral thermal-overload protection.
   6. Low Ambient Kit: Permits operation down to 45 deg F

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
   1. Compressor time delay.
   2. 24-hour time control of system stop and start.
   3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
   4. Fan-speed selection including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

F. Drain Hose: For condensate.

G. Additional Monitoring:
   1. Monitor constant and variable motor loads.
   3. Monitor economizer cycle.
   4. Monitor cooling load.
   5. Monitor air distribution static pressure and ventilation air volumes.
2.5 CAPACITIES AND CHARACTERISTICS

A. Cooling Capacity: As noted on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:
   1. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
   2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
   1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Section 15179 "Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
   2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Section 15179 "Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

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

END OF SECTION 238126
SECTION 238135 - VARIABLE REFRIGERANT FLOW

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. Base Bid:
1. LG Variable Refrigerant Flow zoning system with heat recovery.
2. The system shall consist of an outdoor unit, heat recovery box controllers, multiple indoor units, and DDC (Direct Digital Controls) interface. Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. To ensure owner comfort, each indoor unit or group of indoor units shall be independently controlled and capable of changing mode automatically when zone temperature strays 1.8 degrees F from set point for ten minutes. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.

B. Alternate Manufacturer:
1. Daikin Variable Refrigerant Flow zoning system with heat recovery and integration with C&C controls.
2. The system provided shall meet all performance and capacity ratings of the base bid system. The contractor shall be responsible for all necessary changes required to implement the alternate equipment manufacturer’s equipment and installation requirements in order to provide a fully integrated and working system. The contractor will be required to submit shop drawings showing all equipment locations, refrigerant piping routing, plumbing piping layout, duct layout, and electrical requirements. All changes required for the alternate manufacturer shall be included and coordinated in the submitted information.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.
1. Refrigerant analysis – see Refrigerant Analysis portion of this specification.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
D. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the proposed ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340/360, 1230 and ISO Standard 13256-1.

E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit. Installing contractor is responsible for full system charge.

F. Refrigerant Analysis:
   1. To improve startup quality, a refrigerant analysis is required prior to commissioning and again during commissioning to check for the following:
      a. Refrigerant Impurities. A perfect blend of 50% difluoromethane (CH2F2) and 50% pentafluoroethane (CHF2CF3) is required. This will affect capacity and efficiency.
      b. Non-Condensables (0% Allowable)
      c. Air (0% allowable)

   2. A tested analysis outside of these guidelines will halt the commissioning process to further examine what went wrong, saving the equipment from undue damage that would have otherwise occurred.
   3. A copy of each analysis shall be provided by the System manufacturer to the installing contractor and to the engineer.
   4. Analysis shall be performed by a Neutronics ULTIMA ID Refrigerant Analyzer

1.7 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer’s recommendation.

1.8 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 CONTROLS

A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.

B. System controls and control components shall be installed in accordance with the manufacturer’s written installation instructions.

C. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.

D. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.

E. Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.

F. System shall be capable of email generation for remote alarm annunciation.

G. Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in the controls system configuration and operation.

1.10 WARRANTY

A. The units shall be covered by the manufacturer’s limited warranty for a period of two (2) years from date of Substantial Completion. Labor associated with Equipment shall be provided by installing contractor during the two year period.
B. If the systems are designed by a certified designer, installed by a contractor that has successfully completed the service course, AND verified with a completed commissioning report submitted to and approved by the manufacturer, then the units shall be covered by an extended manufacturer’s limited warranty for a period of five (5) years from date of installation.

C. In addition the compressor shall have a manufacturer’s limited warranty for a period of seven (7) years from date of installation.

D. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

1.11 INSTALLATION

A. The VRF system shall be installed by a contractor with extensive install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

PART 2 - PRODUCTS

2.1 OUTDOOR UNIT

A. Variable Refrigerant Flow (VRF) HVAC system shall be a variable capacity, direct expansion (DX) heat recovery or heat pump engineered system. The outdoor unit shall consist of one or more cabinet(s) connected through common refrigerant piping. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or combination thereof) through a common refrigerant piping and integrated system controls. Each indoor unit shall be controlled individually. Additionally heat recovery system shall be capable of simultaneous heating and cooling individual zone(s).

B. Simultaneous Cooling and Heating VRF System

1. Heat recovery system shall be an air cooled, system consisting of one to three outdoor unit(s) connected to Heat Recovery unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s).

C. Standards / Certifications

1. Heat pump and heat recovery systems shall have published performance ratings certified by AHRI (Air-Conditioning, Heating, and Refrigeration Institute) and listed in the AHRI Standard 1230 certified product directory.
2. Heat pump and heat recovery system components shall be manufactured in production facilities maintaining the following ISO certifications: ISO 9001 Quality Management System, ISO 14001 Environmental Management System.
4. Heat pump and heat recovery system electrical power wiring shall be installed according to National Electrical Code (NEC) and all applicable state and local building codes.

D. Heat Recovery System

1. General
   a. The air-conditioning system shall use R410A refrigerant.
   b. Each system shall have one, two or three air source outdoor units.
   c. Dual and triple frame configurations shall be field piped together using manufacturer’s designed and supplied Y-branch kit and field provided interconnecting pipe to form a common refrigerant circuit.
   d. Refrigerant circuit configuration for Heat Recovery System
      1) The refrigerant circuit shall be constructed using field provided copper piped together with manufacturer supplied Heat Recovery unit(s) and Y-branches or Header fittings connected to multiple (ducted, non-ducted or combination thereof) indoor units to effectively and efficiently control the simultaneous heating and cooling operation of the VRF system.
      2) Each refrigerant pipe, y-branch, header kit, elbows and valves shall be individually insulated with no air gaps. All joints shall be glued and sealed.
   e. Refrigerant circuit configuration for Heat Pump System
      1) The refrigerant circuit shall be constructed using field provided copper piped together with manufacturer supplied Y-branches or Headers connected to multiple (ducted, non-ducted or combination thereof) indoor units to effectively and efficiently control heating or cooling operation of the VRF system.
2) All refrigerant pipe, y-branch, header kit, elbows and valves shall be individually insulated with no air gaps. All joints shall be glued and sealed.

f. Factory installed microprocessor controls in the outdoor unit(s), HR unit(s), and indoor unit(s) shall perform functions to efficiently operate the VRF system and communicate in a daisy chain configuration between outdoor unit and HR unit(s) and indoor unit(s) via RS485.

g. The system shall be designed to accept connection up to 64 indoor units.

h. The system shall be capable of performing continuous operation when an individual indoor unit is being serviced or power to indoor unit is disconnected.

i. The maximum allowable system combination ratio shall be 130%. Systems designed with combination ratio above 130% are not acceptable.

j. The total nominal capacity of all indoor units shall be no less than 50% and no more than 130% of outdoor unit's nominal capacity to ensure the VRF system will have sufficient capacity to meet the building's cooling and heating load at design day weather conditions.

k. The outdoor unit shall have a fusible plug.

l. The fusible plug shall have a threaded connector.

m. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, compressor, contacts, relay(s), power and communications wiring necessary.

n. Each outdoor unit refrigeration circuit shall have the following components:
   1) Refrigerant strainer(s)
   2) Check valve(s)
   3) Oil separator
   4) Accumulator
   5) 4-way reversing valve
   6) Vapor injection valve
   7) Variable path valve
   8) Oil balancing valve for Hi-POR (Available for 12 & 14 ton only)
   9) Oil Level sensor
   10) Electronic expansion valve(s)
   11) Sub-cooler
   12) High and low side Schrader valve service ports with caps.
   13) Service valves

2. System
   a. System shall have a variable flow path heat exchanger function to vary the refrigerant flow path based on system operating mode and operating conditions.
   b. System shall have a medium pressure suction gas vapor injection function.
   c. System shall have an active refrigerant control function to vary the system refrigerant quantity based on operating mode and operating conditions.
   d. System shall have following frame sizes vs. capacity.
      1) 12 and 14 ton units shall be a single frame only.
      2) 22 and 24 ton units shall be dual frame only.
      3) 30 to 36 ton heat recovery units shall be triple frame only

3. Refrigerant Pipe System Design Parameters
   a. The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively.
   b. The outdoor unit shall be capable of operating with up to 3280 equivalent length feet of interconnecting liquid line refrigerant pipe in the network.
   c. The outdoor unit shall be capable of operating with up to 656 actual feet or 738 equivalent length feet of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.

4. Defrost Operations
   a. The outdoor unit(s) shall be capable of Intelligent defrost operation to melt accumulated frost, snow and ice that may have accumulated on the outdoor unit heat exchanger. The defrost cycle length and sequence shall be based on outdoor ambient temperatures, outdoor unit heat exchanger temperature, and various differential pressure variables.
   b. Defrost Mode Selection: The outdoor unit shall be provided with three field selectable defrost operation modes: Normal, Fast, or Forced.
      1) Normal Defrost operation intended for use in areas of the country with mild winter temperatures and light to moderate humidity levels. The strategy minimizes defrost cycle frequency allowing frozen precipitation to build longer in between cycles. Minimum time between defrost cycles shall be 20 minutes. Intelligent Defrost shall choose between split coil/frame and full system methods to minimize energy consumption and cycle time.
      2) Fast Defrost operation intended for use in areas of the country that experience adverse winter weather with periods of heavy winter precipitation and extremely low temperatures. This strategy shall maximize the systems heating performance and maintain operational efficiency. When the ambient temperature is above 32°F, Intelligent Defrost shall continue to heat until the discharge temperature declines. At temperatures below 32°F, the time between defrost
cycles shall be a minimum of 90 minutes. At temperatures below 4°F, a defrost cycle shall occur every two hours to optimize system heating efficiency.

3) Forced Defrost operation shall be available for the service provider to test defrost operations at any weather condition and to manually clear frozen water from the outdoor coil surfaces.

c. Defrost Method Selection: The outdoor unit shall be provided with two field selectable defrost operation methods; Split Coil/Frame and Full System.

1) Split Coil/Frame method shall be available when Normal Defrost mode is selected. Split Coil method shall be available on all Heat Pump and Heat Recovery single-frame VRF systems. Split Frame defrost shall be available on all Heat Pump and Heat Recovery multi-frame outdoor units.

2) Split Coil method shall remove ice from the bottom half of the outdoor unit coil first for six minutes, then the bottom half for six minutes. Next the bottom coil shall be heated again for an additional three minutes to remove any frozen water that may have dripped onto the lower coil during the top coil defrost operation.

3) When Split Coil/Frame method is selected, a Full System defrost shall be occur every third defrost cycle to assure 100% of the frozen precipitation has been removed to maintain efficient performance.

4) Full System method shall be available as a field selectable option. All outdoor units located in areas of the country where large volumes of frozen precipitation are common, the commissioning agent shall select the Full System defrost method.

d. Indoor Unit Fan Operation During Defrost

1) During partial defrost operation indoor units operating in cooling or dry mode shall continue normal operation.

2) During partial defrost operation, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the defrost cycle.

3) During full system defrost operation indoor unit fans will cycle off and remain off during the remainder of the defrost cycle.

5. Oil Management

a. The system shall have High Pressure Oil Return to ensure a consistent film of oil on all moving compressor parts at low speed. Oil is returned to compressor through a separate oil injection pipe.

1) Oil return system shall maintain high side pressure return to the compressor

b. The system shall be provided with a centrifugal oil separator designed to extract oil from the oil/refrigerant gas stream leaving the compressor and return the extracted oil to the compressor oil sump.

c. The system shall have an oil level sensor in the compressor to provide direct oil level sensing.

d. The system shall only initiate an oil return cycle if the oil level is too low.

e. Timed oil return operations or non-oil level sensing systems shall not be permitted.

6. Cabinet

a. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with an enamel finish.

b. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.

c. The front panels of the outdoor units shall be removable type for access to internal components.

d. A smaller service access panel, not larger than 6.25”x 6.67” and secured by a maximum of (2) screws shall be provided to access the following:

1) Service tool connection

2) DIP switches

3) Auto addressing

4) Error codes

e. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front or through the bottom of the unit.

7. Fan Assembly

a. Each 6 ton cabinet shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge.

b. Each 8 to 14 ton cabinet shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.

c. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.

d. The fan(s) motor shall be equipped with permanently lubricated bearings.

e. The fan motor shall be variable speed with a maximum operating speed of 1050 RPM.

f. The fan shall have a raised guard to help prevent contact with moving parts.

g. The cabinet shall have option to change the discharge air direction from vertical to horizontal using optional factory provided air guides.

h. The cabinet shall have a DIP switch setting to raise external static pressure up to 0.32 in-wg.

8. Outdoor Unit Coil

a. Shall be a variable path design.
b. Shall be provided and built by the VRF outdoor unit provider.

c. It shall be comprised of aluminum fins mechanically bonded on copper tubing.

d. The copper tubes shall have inner groves.

e. The aluminum fins shall have factory applied corrosion resistant GoldFin™ material.

f. Hydrophilic Coil coating shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.

g. The outdoor unit coil shall be tested to a pressure of 551 psig.

h. The coil for each cabinet shall have 14 Fins per Inch (FPI).

i. All the outdoor units shall have a 3 rows heat exchanger.

j. The cabinet shall have a coil guard.

9. Compressor(s)
   a. Each 6, 8, 10 ton cabinet shall be equipped with one hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressor.
   b. The 12 and 14 ton cabinet shall be equipped with two hermetically sealed, inverter driven, HSS controlled scroll compressors.
   c. Each inverter driven, HSS scroll compressor shall be capable of operating in a frequency range from 15 Hz to 150 Hz with control in 0.5 Hz increments.
   d. The compressor(s) shall be equipped with a 60 Watt crankcase heater.
   e. The compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
   f. The compressor bearing(s) shall have Teflon™ coating.
   g. The compressor(s) shall be protected with:
      1) High Pressure switch
      2) Over-current /under current protection
      3) Phase failure
      4) Phase reversal

h. Standard, non-inverter driven compressors shall not be permitted

10. Sound Levels
    a. Each cabinet shall be rated with a sound level not to exceed 59.5 dB(A) when tested in an anechoic chamber under ISO3745 standard.

11. Sensors
    a. Each single cabinet shall have
       1) Suction temperature sensor
       2) Discharge temperature sensor
       3) High Pressure sensor
       4) Low Pressure sensor
       5) Outdoor temperature sensor
       6) Outdoor unit heat exchanger temperature sensor

2.2 HEAT RECOVERY UNIT

A. General
   1. HR unit shall be designed and manufactured by the same manufacturer of VRF indoor unit(s) and outdoor unit(s).
   2. HR unit casing shall be made with galvanized steel.
   3. HR unit shall require 208-230V/1-phase/60Hz power supply.
   4. HR Unit shall be an intermediate refrigerant control device between the air source outdoor unit and the indoor units to control the systems simultaneous cooling and heating operation.
   5. HR unit shall be engineered to work with a three pipe VRF system comprising of
      a. High Pressure Vapor Pipe
      b. Low Pressure Vapor Pipe
      c. Liquid Pipe
   6. HR unit shall be designed to be piped in series or parallel.
   7. HR unit shall have 2, 3 or 4 ports.
   8. Each port shall be capable of operating in cooling or heating independently regardless of the operating mode of any other port on the HR unit or in the system.
   9. Each port shall be capable of connecting from 1 to 8 indoor units to a maximum nominal capacity of 54MBh.
   10. Maximum nominal capacity per HR unit shall not exceed 192MBh.
   11. Indoor units greater than 54MBh nominal capacity shall be twinned using a reverse Y-branch.
   12. HR unit shall be internally piped, wired, assembled and run tested at the factory.
   13. HR unit shall be designed for installation in a conditioned environment.
   14. HR unit shall have a liquid bypass valve.
   15. HR unit shall have (2) two-position solenoid valves per port.
   16. HR unit shall have a balancing valve to control the pressure between the high pressure and low pressure pipe during mode switching.
17. HR unit shall have an electronic expansion valve for subcooling.
18. HR unit shall not require a condensate drain.
19. HR unit shall be internally insulated.
20. All field refrigerant lines between outdoor unit and HR unit and from HR unit to indoor unit shall be field insulated.
21. The HR unit shall not exceed a net weight of 49 lbs.
22. The system shall be designed to accommodate 16 HR units connected to Heat Recovery units piped in single series string.
23. A single series pipe string of 1 to 16 HR units shall be capable of serving indoor units with a total nominal capacity of 192 MBH per HR unit.

B. Piping Capabilities
1. The elevation difference between indoor units on heat pump systems shall be 131 feet.
2. The elevation differences for heat recovery systems shall be:
   a. Heat recovery unit (HRU) to connected indoor unit shall be 49 feet
   b. HRU to HRU shall be 49 feet
   c. Indoor unit to indoor unit connected to same HRU shall be 49 feet
   d. Indoor unit to indoor unit connected to separate parallel HRU’s shall be 131 feet.
3. The acceptable elevation difference between two series connected HR units shall be 16 feet.

C. Controls
1. HR unit(s) shall have factory installed unit mounted control boards and integral microprocessor to communicate with other devices in the VRF system.
2. HR unit shall communicate with the air source unit via the air source/indoor unit 2-conductor shielded communications cable terminated using a daisy chain configuration.
3. The VRF manufacturer shall provide published documentation that specifically allows the installation of field provided isolation valves on all pipes connected to the Heat Recovery unit to allow the servicing of HR units refrigerant circuit or the replacement of HR unit without evacuating the balance of the piping system.

2.3 INDOOR UNITS

A. Standards / Certifications
1. Indoor unit components shall be manufactured in production facilities maintaining the following ISO certifications: ISO 9001 Quality Management System, ISO 14001 Environmental Management System

B. Wall Mounted
1. General:
   a. Unit shall be factory assembled, wired, piped and run tested.
   b. Unit shall be designed to be installed for indoor application.
   c. Unit shall be attached to an installation plate/bracket that secures unit to the wall.
   d. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.
   e. The depth of the unit shall not exceed 10 inches.
2. Casing/Panel
   a. Unit case shall be manufactured using Acrylonitrile Butadiene Styrene (ABS) polymeric resin and has a morning fog finish.
3. Cabinet Assembly:
   a. Unit shall have one supply air outlet and one return air inlet.
   b. Unit shall be equipped with factory installed temperature thermistors for:
      1) Return air
      2) Refrigerant entering coil
      3) Refrigerant leaving coil
   c. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
   d. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
   e. Unit shall have the following functions as standard:
      1) Self-diagnostic function
      2) Auto addressing
      3) Auto restart function
      4) Auto changeover function (Heat Recovery system only)
      5) Auto operation function
      6) Auto clean function
      7) Child lock function
8) Forced operation
9) Dual thermistor control
10) Sleep mode
11) Dual setpoint control
12) Filter life and power consumption display
f. Unit shall be capable of refrigerant piping in 4 different directions.
g. Unit shall be capable of drain piping in 2 different directions.

4. Fan Assembly:
   a. The unit shall have a single, direct driven, crossflow tangential Sirocco fan made of high strength ABS BSN-7530 polymeric resin.
   b. The fan impeller shall be statically and dynamically balanced.
   c. The fan motor is Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
   d. The fan motor shall include thermal, overcurrent and low RPM protection.
   e. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
   f. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
   g. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Power Cool, and Auto.
   h. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
i. Unit shall have factory installed motorized louver to provide flow of air in up and down direction for uniform airflow.
j. Unit shall have factory installed motorized guide vane to control the direction of flow of air from side to side.

5. Filter Assembly:
   a. The return air inlet shall have a factory supplied removable, washable filter with antifungal treatment.
   b. The unit shall have the option for a secondary plasma filter accessory.
   c. The filter access shall be from the front of the unit.

6. Coil Assembly:
   a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
   b. The copper tubing shall have inner grooves for high efficiency heat exchanger.
   c. Unit shall have a minimum 2 row coil, 18 fins per inch.
   d. Unit shall have a factory supplied condensate drain pan below the coil constructed of EPS (expandable polystyrene resin).
   e. Unit shall be designed for gravity drain.
   f. Unit shall have a factory insulated drain hose to handle condensate.
   g. Unit shall have provision of 45° flare refrigerant pipe connections.
   h. The coil shall be factory pressure tested at a minimum of 551 psig.
i. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.

7. Microprocessor Control:
   a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
   b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
   c. The unit controls shall operate the indoor unit using one of the five operating modes:
      1) Auto changeover (Heat Recovery System only)
      2) Heating
      3) Cooling
      4) Dry
      5) Fan only

8. Electrical:
   a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
   b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

9. Controls:
   a. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

C. Ceiling Cassette – 1 Way, 2Way, 4 Way
1. General:
   a. Unit shall be factory assembled, wired, piped and run tested.
   b. Unit shall be designed to be installed for indoor application.
   c. Unit shall be designed to mount recessed in the ceiling and has a surface mounted grille on the bottom of the unit.
   d. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.

2. Casing/Panel
   a. Unit case shall be manufactured using galvanized steel plate.
b. The unit shall be provided with an off-white Acrylonitrile Butadiene Styrene (ABS) polymeric resin architectural grille.
c. The grille shall have a tapered trim edge, and a hinged, spring clip (screw-less) return air filter-grille door.
d. Unit shall be provided with metal ears designed to support the unit weight on four corners.
e. Ears shall have pre-punched holes designed to accept field supplied all thread rod hangers.

3. Cabinet Assembly:
   a. 1 Way
      1) Unit shall have one supply air outlet and one return air inlet.
      2) The supply air outlet shall be through a single directional slot diffuser with oscillating motorized guide vane designed to change the airflow direction.
      3) The grille shall have a discharge range of motion of 40° in an up/down direction with capabilities of locking the vanes.
      4) Unit shall have factory installed motorized louver to provide flow of air in up and down direction for uniform airflow.
   b. 2 Way
      1) Unit shall have two supply air outlets and one return air inlet.
      2) The supply air outlets shall have two parallel directional slot diffusers each equipped with oscillating motorized guide vane designed to change the airflow direction.
      3) The grille shall have a discharge range of motion of 40° in an up/down direction with capabilities of locking the vanes.
      4) The unit shall have a guide vane algorithm designed to sequentially change the predominant discharge airflow direction in counterclockwise pattern.
      5) Guide vanes shall provide airflow in all directions.
   c. 4 Way
      1) Unit shall have four supply air outlets and one return air inlet.
      2) The supply air outlet shall be through four-directional slot diffuser each equipped with independent oscillating motorized guide vane designed to change the airflow direction.
      3) The grille shall have a discharge range of motion of 40° in an up/down direction with capabilities of locking the vanes.
      4) The unit shall have a guide vane algorithm designed to sequentially change the predominant discharge airflow direction in counterclockwise pattern.
      5) Guide vanes shall provide airflow in all directions.
   d. Unit shall be equipped with factory installed temperature thermistors for:
      1) Return air
      2) Refrigerant entering coil
      3) Refrigerant leaving coil
   e. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
   f. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
   g. The unit shall have provision of fresh air ventilation through a knock-out on the cabinet.
   h. Unit shall have the following functions as standard:
      1) Self-diagnostic function
      2) Auto addressing
      3) Auto restart function
      4) Auto changeover function (Heat Recovery system only)
      5) Auto operation function
      6) Child lock function
      7) Forced operation
      8) Dual thermistor control
      9) Sleep mode
      10) Dual setpoint control
      11) Multiple aux heater applications
      12) Filter life and power consumption display

4. Fan Assembly:
   a. The unit shall have a single, direct driven, crossflow tangential Sirocco fan made of high strength ABS GP-2305 polymeric resin.
   b. The fan impeller shall be statically and dynamically balanced.
   c. The fan motor is Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
   d. The fan motor shall include thermal, overcurrent and low RPM protection.
   e. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
   f. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
   g. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Power Cool, and Auto.
5. Filter Assembly:
   a. The return air inlet shall have a factory supplied removable, washable filter with antifungal treatment.
   b. The unit shall have the option for a secondary plasma filter accessory.
   c. The filter access shall be from the bottom of the unit.

6. Coil Assembly:
   a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
   b. The copper tubing shall have inner grooves for high efficiency heat exchanger.
   c. Unit shall have a minimum 2 row coil, 21 fins per inch.
   d. Unit shall have a factory supplied condensate drain pan below the coil constructed of EPS (expandable polystyrene resin).
   e. Unit shall have a factory supplied condensate drain pan below the coil.
   f. Unit shall include an installed and wired condensate drain pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
   g. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
   h. Unit shall have provision of 45° flare refrigerant pipe connections.
   i. The coil shall be factory pressure tested at a minimum of 551 psig.
   j. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.

7. Microprocessor Control:
   a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
   b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
   c. The unit controls shall operate the indoor unit using one of the five operating modes:
      1) Auto changeover (Heat Recovery System only)
      2) Heating
      3) Cooling
      4) Dry
      5) Fan only

8. Electrical:
   a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
   b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

9. Controls:
   a. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

D. Ducted – High Static

1. General:
   a. Unit shall be factory assembled, wired, piped and run tested.
   b. Unit shall be designed to be installed for indoor application.
   c. Unit shall be designed to mount fully concealed above the finished ceiling.
   d. Unit shall have opening to supply air from front horizontal and a dedicated rear horizontal return.
   e. The supply air shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.
   f. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.

2. Casing/Panel
   a. Unit case shall be manufactured using galvanized steel plate.
   b. The cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.
   c. The cold surfaces of the unit shall be covered externally with sheet insulation made of Ethylene Propylene Diene Monomer (M-Class) (EPDM)
   d. The external insulation shall be plenum rated and conform to ASTM Standard D-1418.
   e. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
   f. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.

3. Cabinet Assembly:
   a. Unit shall have supply air discharge outlets horizontal and a return air inlet horizontal.
   b. Unit shall be equipped with factory installed temperature thermistors for:
      1) Return air
      2) Refrigerant entering coil
      3) Refrigerant leaving coil
   c. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
   d. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
   e. Unit shall have the following functions as standard:
1) Self-diagnostic function
2) Auto addressing
3) Auto restart function
4) Auto changeover function (Heat Recovery system only)
5) Auto operation function
6) Child lock function
7) Forced operation
8) Dual thermistor control
9) Sleep mode
10) External static pressure (ESP) control
11) Dual setpoint control
12) Multiple aux heater applications
13) Filter life and power consumption display

4. Fan Assembly:
   a. The unit shall have two direct drive Sirocco fans made of high strength ABS GP-2200 polymeric resin.
   b. The fan impeller shall be statically and dynamically balanced.
   c. The fans shall be mounted on a common shaft.
   d. The fan motor is Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
   e. The fan motor shall include thermal, overcurrent and low RPM protection.
   f. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
   g. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
   h. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Power Cool, and Auto.
   i. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
   j. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
   k. Unit shall be designed for high speed air volume against an external static pressure of up to 0.98" water gauge.

5. Filter Assembly:
   a. The return air inlet shall have a factory supplied removable, washable filter with antifungal treatment.
   b. The filter access shall be from the rear of the unit.

6. Coil Assembly:
   a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
   b. The copper tubing shall have inner grooves for high efficiency heat exchanger.
   c. Unit shall have a minimum 2-3 row coil, 19-21 fins per inch.
   d. Unit shall have a factory supplied condensate drain pan below the coil constructed of HIPS (high impact polystyrene resin).
   e. Unit shall include an installed and wired condensate drain pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
   f. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
   g. Unit shall have provision of 45° flare refrigerant pipe connections.
   h. The coil shall be factory pressure tested at a minimum of 551 psig.
   i. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.

7. Microprocessor Control:
   a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
   b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
   c. The unit controls shall operate the indoor unit using one of the five operating modes:
      1) Auto changeover (Heat Recovery System only)
      2) Heating
      3) Cooling
      4) Dry
      5) Fan only

8. Electrical:
   a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
   b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

9. Controls:
   a. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

E. Ducted – Vertical/Horizontal Air Handling Unit

1. General:
a. Unit shall be factory assembled, wired, piped and run tested.
b. Unit shall be designed to be installed for indoor application.
c. Unit shall be designed to mount fully concealed behind the wall or above the finished ceiling.
d. The unit case shall be designed to accept an internal, optional LG electric strip heater.
e. The supply air shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.
f. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.

2. Casing/Panel
   a. Unit case shall be manufactured using 22-gauge Pre Coated Metal (PCM).
   b. The external surface shall be finished with a high gloss baked enamel finish.
   c. The finish color shall be morning fog.
   d. The cold surfaces of the unit shall be internally insulated with ½” foil faced polystyrene fiber insulation.
   e. The inside surface of fan assembly door access panel shall be treated with ½” polystyrene fiber insulation, encapsulated on both sides.
   f. The access panel shall be sealed along the edges with reinforced foil faced covering to prevent deterioration caused by panel removal.
   g. All the access panels shall be provided with gasket seals to minimize air leakage.
   h. The external insulation shall be plenum rated and conform to ASTM Standard D-1418.

3. Cabinet Assembly:
   a. The unit shall be designed to operate in the vertical (upflow) configuration or horizontal (left) end discharge.
   b. Unit shall have opening for supply air from top with a dedicated bottom vertical return.
   c. Unit shall be equipped with factory installed temperature thermistors for:
      1) Return air
      2) Refrigerant entering coil
      3) Refrigerant leaving coil
   d. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
   e. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
   f. Unit shall have the following functions as standard:
      1) Self-diagnostic function
      2) Auto addressing
      3) Auto restart function
      4) Auto changeover function (Heat Recovery system only)
      5) Auto operation function
      6) Child lock function
      7) Forced operation
      8) Dual thermistor control
      9) Sleep mode
     10) External static pressure (ESP) control
     11) Dual setpoint control
     12) Multiple aux heater applications
     13) Filter life and power consumption display

4. Fan Assembly:
   a. The unit shall have an integral fan assembly consisting of galvanized steel housing and forward curve fan wheel.
   b. The fan motor is Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
   c. The fan motor shall include thermal, overcurrent and low RPM protection.
   d. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
   e. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
   f. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Power Cool, and Auto.
   g. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
   h. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
   i. Unit shall be designed for high speed air volume against an external static pressure of up to 1.0” water gauge.

5. Filter Assembly:
   a. The unit comes with a filter rack capable of accepting a field supplied 16” x 20” x 1” filter cartridge
   b. The filter rack shall be equipped with guides to keep filter centered in the rack.
   c. The filter access shall be from the front of the unit without removing coil or fan area access panel.
   d. The filter access door shall be fitted with thumb screws that can be removed without the use of any tool.

6. Coil Assembly:
a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
b. The copper tubing shall have inner grooves for high efficiency heat exchanger.
c. Unit shall have minimum 2-3 row coil, 18 fins per inch.
d. Unit shall have a factory supplied condensate drain pan below the coil constructed of HIPS (high impact polystyrene resin).
e. Unit shall be designed for gravity drain.
f. The unit shall have a secondary drain port plug for overflow.
g. Unit shall have provision of 45° flare refrigerant pipe connections.
h. The coil shall be factory pressure tested at a minimum of 551 psig.
i. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.

7. Microprocessor Control:
   a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
   b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
   c. The unit controls shall operate the indoor unit using one of the five operating modes:
      1) Auto changeover (Heat Recovery System only)
      2) Heating
      3) Cooling
      4) Dry
      5) Fan only

8. Electrical:
   a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
   b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

9. Controls:
   a. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

2.4 CONTROLS

A. System Description
   1. The controls Network is to be an integrated controls platform the manufacturer’s Variable Refrigerant Flow (VRF) systems. The customizable Controls Network allows the level of control to match the needs of the building and its occupants. Controls Network offers several controller options for the occupant(s) of the space, central controller options for facilities management personnel, application controllers for third-party equipment control, and BACnet™ interface for integration with Building Management Systems (BMS).

B. Quality Assurance
   1. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which are environmental protection standards set by the International Organization for Standardization (ISO).
   2. All wiring shall be in accordance with the National Electrical Code (NEC).
   3. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

C. Storage and Handling
   1. All VRF controllers shall be stored and protected from weather, extreme temperature, etc., as suggested by the manufacturer. All VRF controllers shall be moved, lifted, etc., as suggested by the manufacturer.

D. Warranty
   1. Controls and Accessories shall be warranted by the manufacturer’s limited warranty for replacement of malfunctioning components and specific software upgrades to meet application engineering needs for one (1) year from the date of original retail purchase.
   2. The VRF system shall be installed by a licensed mechanical contractor trained by the VRF equipment manufacturer or installation professional.
   3. Commissioning shall be performed by the manufacturer or installation professional.

E. Remote Controller
   1. Overview:
      a. The Remote Controller shall be capable of controlling up to 16 indoor units (1 group). The Remote Controller shall be capable of monitoring and controlling the group in terms of On/Off, Mode of Operation, Airflow direction, Fan Speed, space temperature, and space temperature Set Point based on the available functions of the connected system. Additionally the Remote Controller shall be capable of providing 7 day programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of operation, Set Point and Fan Speed.
Remote Controllers shall be capable of communicating via the BACnet MS/TP protocol and the ability to communicate with wireless sensors using a ZigBee Pro Wireless Sensor network.

2. General:
   a. Remote Controllers shall communicate to the VRF indoor unit via the indoor unit remote controller communication bus.
   b. Remote Controllers shall be able to communicate with a BMS using BACnet MS/TP protocol.
   c. Remote Controllers shall have the ability to communicate with wireless sensors using a ZigBee Pro Wireless Sensor network.
   d. Remote Controllers shall have a touch-screen, backlit, LCD display with screen saver capability.
   e. The Remote Controller shall support the ability to display or hide user accessible functions from the home screen.
   f. The Remote Controller shall have an internal time clock and calendar.
   g. Remote Controllers shall communicate to the VRF indoor unit via the indoor unit remote controller communication bus.
   h. Remote Controllers shall be able to communicate with a BMS using BACnet MS/TP protocol.
   i. Remote Controllers shall have the ability to communicate with wireless sensors using a ZigBee Pro Wireless Sensor network.
   j. The Remote Controller shall be able to display temperature in °F or °C based on user settings and shall be able to be configured in either °F or °C for all functions.
   k. The Remote Controller shall allow the creation of five scheduled events per day.
   l. The Remote Controller shall support the creation of five scheduled events per day.
   m. The Remote Controller shall have a touch-screen, backlit, LCD display with screen saver capability.
   n. The Remote Controller shall be able to display temperature in °F or °C based on user settings and shall be able to be configured in either °F or °C for all functions.
   o. The Remote Controller shall be able to display temperature in °F or °C based on user settings and shall be able to be configured in either °F or °C for all functions.
   p. Remote Controllers shall be able to initiate a Power Cooling Mode if supported by the available functions of the connected system.

F. Communications Manager

1. Overview:
   a. The Communication Manager provides multiple energy management schemes and integrates with third-party Building Automation Systems via BACnet, LON and Fox protocols. The Communication Manager shall be configurable via a standard web browser requiring no additional software. Additionally, the Communication Manager shall be capable of providing daily, weekly, yearly, and holiday programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed based on the available functions of the connected system.

2. General:
   a. The Communication Manager shall communicate to the indoor unit via the VRF RS-485 daisy chain communication protocol.
   b. The Communication Manager shall be shipped pre-configured to communicate with the indoor unit via the VRF RS-485 daisy chain communication protocol.
   c. The Communication Manager shall have a touch-screen, backlit, LCD display with screen saver capability.
   d. The Communication Manager shall be able to display temperature in °F or °C based on user settings and shall be able to be configured in either °F or °C for all functions.
   e. The Communication Manager shall be able to display temperature in °F or °C based on user settings and shall be able to be configured in either °F or °C for all functions.
   f. The Communication Manager shall have two setpoint auto changeover.
   g. The Communication Manager shall have occupied/unoccupied setpoint control.
   h. The Communication Manager shall have remote zone controller lockout (Setpoint, Mode).
   i. The Communication Manager shall be able to support registration as a foreign device.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Rig and install in full accordance with manufacturer’s requirements, project drawings, and contract documents. Refer to the manufacturer’s installation manual for full requirements.

B. Equipment Mounting: Locate indoor and outdoor units as indicated on drawings. Provide service clearance per manufacturer’s installation manual. Adjust and level outdoor units on support structure.
1. Install units level and plumb.
2. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
3. Install roof-mounted, compressor-condenser components on equipment supports specified in other sections. Anchor units to supports with removable, cadmium-plated fasteners.
4. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
5. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. For climates that experience snowfall, mount the outdoor unit a minimum of 12'' above the average snowfall line. In climates where this height requirement proves unfeasible, the outdoor units may be installed at the average snowfall line provided regular snow removal in the area surrounding the units keeps the snow line below the bottom of the units.

D. Components / Piping:
1. Installing contractor shall provide and install all accessories and piping for a fully operational system. Refer to manufacturer's installation manual for full instructions.
2. Traps, filter driers, and sight glasses are NOT to be installed on the refrigerant piping or condensate lines.
3. Standard ACR fittings rated for use with R410A are to be used for all connections. Proprietary manufacturer-specific appurtenances are not allowed.
4. Refrigerant pipe shall be made of phosphorus deoxidized copper, and has two types.
   a. ACR Type-L "Annealed Temper": Soft copper pipe, can be easily bent with human's hand.
   b. ACR Type L "Drawn Temper": Hard copper pipe (Straight pipe), being stronger than Type-O pipe of the same radical thickness.
5. The maximum operation pressure of R410A air conditioner is 4.30 MPa. The refrigerant piping should ensure the safety under the maximum operation pressure. Refer to recommended piping specifications in manufacturer's engineering manual. Pipes of radical thickness 0.7mm or less shall not be used.
6. Flare connection should follow dimensions provided in manufacturer's installation manuals.

E. Insulation: Refrigerant lines, as well as any valves, shall be insulated end to end. Refer to Section 230719.

F. Electrical: Installing contractor shall coordinate electrical requirements and connections for all power feeds with electrical contractor. Refer to Division 26 for additional information.

G. Third Party Controls: Installing contractor shall coordinate all BAS/BMS control requirements and connections with the district system.

3.2 CONNECTIONS
A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL
A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

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. Refrigerant analysis by system manufacturer – see Refrigerant Analysis portion of this specification

3.5 DEMONSTRATION

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

END OF SECTION 238135
SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves for raceways and cables.
   2. Sleeve seals.
   4. Common electrical installation requirements.

1.2 SUBMITTALS

A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   3. Pressure Plates: Plastic. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section “Joint Sealants.”

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section “Penetration Firestopping.”

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe 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.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500
SECTION 260502 - EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes limited scope for electrical connections to equipment specified under other Sections or Divisions, or furnished under separate contracts or by the Owner.

B. Related Sections include the following:
1. Division 23 Section “Digital Control Equipment” for temperature control wiring.
2. Division 26 Section “General Electrical Requirements” for general requirements and related documents that apply to this Section.
3. Division 26 Section “Raceway and Boxes for Electrical Systems” for raceways.
4. Division 26 “Low-voltage Electrical Power Conductors and Cables” for conductors, cables, and cords.
5. Division 26 Section “Wiring Devices” for devices installed in boxes and for floor-box service fittings.

1.2 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
2. Marked for intended use.

B. Comply with NFPA 70.

1.3 COORDINATION
A. Unless otherwise noted, perform all electrical Work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

B. Coordinate work with Division 23 Section, “Common Work Results for HVAC”.

C. Coordinate with work described in Division 23 Section “Direct-Digital Control for HVAC”.

D. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.

E. Determine connection locations and rough-in requirements based on Shop Drawings.

F. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

G. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS
A. Attachment Plugs: Conform to NEMA WD 1.

B. Configuration: NEMA WD 6, matching receptacle configuration at outlet provided for equipment, or as required by the equipment manufacturer.

C. Cord: See Paragraph “Flexible Cords” in Division 26 Section “Low-voltage Electrical Power Conductors and Cables”.

D. Provide cord size suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify conditions of equipment and installation prior to beginning work.
   B. Verify that equipment is ready for connecting, wiring, and energizing.

3.2 ELECTRICAL DEVICES
   A. Install disconnect switches, controllers, control stations, and control devices (other than temperature control
devices) as indicated.
   B. Install disconnect switches, controllers, control stations, and control devices (other than temperature control
devices) specified in other Divisions of these Specifications, furnished under other contracts, and/or furnished
   by the Owner for installation under this Contract.

3.3 ELECTRICAL CONNECTIONS
   A. Make electrical connections in accordance with equipment manufacturers’ instructions.
   B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with
   watertight connectors in damp or wet locations.
   C. Make wiring connections using conductors and cable with insulation suitable for temperatures encountered in heat
   producing equipment.
   D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-
supplied attachment plug is indicated on the Drawings.
   E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection
   boxes.
   F. Provide interconnecting conduit and wiring between devices and equipment where indicated on the Drawings.

3.4 HVAC EQUIPMENT
   A. Provide power connection to all equipment as required and as indicated in the equipment supplier’s installation
drawings.
   B. Provide all control and interlock wiring for all equipment that is not included within the responsibility of
   Division 22 or 23.
   C. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings
   as field wiring, will be provided by the equipment supplier, unless otherwise noted.

3.5 DOOR OPERATORS AND HARDWARE
   A. Provide electrical connections to automatic entry doors, automatic corridor doors, electrically held door latches,
   remote release doors, and all other required electrical connections for door systems included in other sections of
   these specifications.
   B. Provide power connection to all equipment as required and as indicated in the equipment supplier’s installation
drawings.
   C. Provide all control wiring and conduit for all equipment that is not included within the responsibility of the door
   hardware installer. Provide connection from junction boxes to the door operators or hardware and from door
   operators to actuation devices as required. Install key operated switches, pushpad switches, and other electrically
   controlled door operation devices furnished by other divisions within this contract.
D. Provide fire alarm devices and wiring as required for proper operation of door systems in accordance with the NFPA codes.

3.6 SECURE BUILDING SYSTEMS

A. Provide all work related to Division 26 required for the secure building system equipment. Note that this work has not been entirely duplicated and indicated on the sheets with E prefixes, rather only a minimum amount as required for coordination with other systems, and as required to comply with local codes. The security system installer has prepared complete installation drawings. Prior to rough-in and final connection coordinate with final equipment installation diagrams, drawings, manuals, and specifications. Such equipment may include but shall not be limited to the following: access control systems, video surveillance and monitoring systems, entry detection systems, motion detection systems, door position monitoring systems, etc.

B. Provide power connection to equipment as indicated or as otherwise required to accommodate the equipment and associated systems.

C. Provide raceways, conduit, back boxes and cabling for control wiring as required to accommodate the equipment indicated in the installation drawings and specifications that is not indicated as being within the responsibility of the equipment installer. Coordinate specific raceway and box requirements with the equipment installer prior to rough-in.

D. Provide signal and control wiring as indicated or that is not included within the responsibility of the equipment installer. Coordinate specific wiring and termination requirements with the equipment installer.

E. Install devices furnished by the equipment supplier that is not included within the responsibility of the system installer.

F. Provide fire alarm system interfaces as indicated, as required by the NFPA Codes, and as required by the equipment supplier.

G. Provide grounding systems as indicated or that is not included within the responsibility of the equipment installer.

3.7 KITCHEN EQUIPMENT

A. Provide all work related to Division 26 required for the kitchen equipment. Note that this work has not been entirely duplicated and indicated on the sheets with E prefixes, rather only a minimum amount as required for coordination with other systems, and as required to comply with local codes. The kitchen equipment planner has prepared a complete set of drawings and manual including all the equipment intended to be purchased, general electrical requirements and associated cut sheets. Review the kitchen equipment manual prior to bid. Prior to rough-in and final connection coordinate with final equipment installation diagrams, drawings, manuals, and specifications. Such equipment may include but shall not be limited to the following: refrigerators, freezers, coolers, ice makers, ovens, fryers, hoods, warmers, mixers, char-broilers, griddles, counters, bases, display cabinets, heated cabinets, prep tables, heated merchandisers, stands, dispensers, brewers, shelving, salad bars, cases, or point of sale systems, etc.

B. Provide power connection to all equipment as indicated or as otherwise required to accommodate the kitchen equipment.

C. Provide all grounding systems as required by the equipment supplier.

D. Provide all fire alarm system connections as required in accordance with applicable codes or per equipment supplier installation requirements.

E. Provide wireways, cable trays, trench duct, wall duct, conduit and all other raceways and boxes as required to accommodate the kitchen equipment that is not indicated as being within the responsibility of the equipment installer.

F. Provide all other equipment, wiring, connections, emergency power off stations, warning lights, interlocks, controls, etc. as required to accommodate the kitchen equipment that is not indicated as being within the responsibility of the equipment installer.

END OF SECTION 260502
SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:
1. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.
B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Alpha Wire Company.
   2. American Bare Conductor.
   3. Belden Inc.
   4. Cerro Wire LLC.
   5. Encore Wire Corporation.
   6. General Cable Technologies Corporation.
   7. Okonite Company (The).
   8. Service Wire Co.
10. WESCO.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:
1. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
2. Type THHN and Type THWN-2: Comply with UL 83.

F. Shield:
1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Cerro Wire LLC.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. Okonite Company (The).
8. Southwire Company.
9. WESCO.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.

E. Conductor Insulation:
1. Type THHN and Type THWN-2: Comply with UL 83.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. AFC Cable Systems; a part of Atkore International.
2. Alpha Wire Company.
3. American Bare Conductor.
4. Belden Inc.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. Okonite Company (The).
8. Service Wire Co.
10. WESCO.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:
1. Type THHN/THWN-2: Comply with UL 83.

H. Armor: Steel, interlocked.

2.4 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
5. Ideal Industries, Inc.
6. ILSCO.
7. NSi Industries LLC.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
10. TE Connectivity Ltd.
11. Thomas & Betts Corporation; A Member of the ABB Group.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
2. Type: Two hole with long barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 2 AWG; copper or aluminum for feeders No. 2 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC. Apply metal-clad cable Type MC in the following manner for branch circuits concealed in ceilings, walls and partitions:
   1. Type MC cable is allowed:
      a. For final connections to recessed light fixtures and wiring devices in accessible ceiling, except in kitchen.
   2. Type MC cable is not allowed:
      a. Above inaccessible ceilings.
      b. Within any type of wall.
      c. In kitchen.
   3. In no circumstances will type MC cable be allowed for branch circuit homeruns.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. VFC Output Circuits: Type TC-ER cable with braided shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
   2. Perform each of the following visual and electrical tests:
      a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
      b. Test bolted connections for high resistance using one of the following:
         1) A low-resistance ohmmeter.
         2) Calibrated torque wrench.
         3) Thermographic survey.
      c. Inspect compression-applied connectors for correct cable match and indentation.
      d. Inspect for correct identification.
      e. Inspect cable jacket and condition.
      f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
      g. Continuity test on each conductor and cable.
      h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519
SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. UTP cabling.
   2. RS-232 cabling.
   3. RS-485 cabling.
   4. Low-voltage control cabling.
   5. Control-circuit conductors.
   6. Identification products.

1.2 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

B. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

1.3 SUBMITTALS

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

B. Field quality-control reports.

C. Maintenance data.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of an NRTL.

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: 25 or less.
   2. Smoke-Developed Index: 450 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

B. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.

B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
   1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry."

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Draka USA.
5. Genesis Cable Products; Honeywell International, Inc.
6. KRONE Incorporated.
7. Mohawk; a division of Belden CDT.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope, Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, four-pair UTP.
1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
   a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Dynacom Corporation.
3. Hubbell Premise Wiring.
4. KRONE Incorporated.
5. Leviton Voice & Data Division.
6. Molex Premise Networks; a division of Molex, Inc.
7. Nordex/CDT; a subsidiary of Cable Design Technologies.
8. Panduit Corp.
10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

2.5 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
2.6 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.
   1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
   2. Fluorinated ethylene propylene insulation.
   3. Unshielded.
   4. Fluorinated ethylene propylene jacket.

2.7 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with NFPA 262.

C. Paired Cable: NFPA 70, Type CMG.
   1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
   1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
   2. Fluorinated ethylene propylene insulation.
   3. Unshielded.

2.8 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.
C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.9 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. HellermannTyton.
   3. Kroy LLC.
   4. Panduit Corp.
B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Pathway Installation in Equipment Rooms:
   1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
   2. Install cable trays to route cables if conduits cannot be located in these positions.
   3. Secure conduits to backboard if entering room from overhead.
   4. Extend conduits 3 inches above finished floor.
   5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
   4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter.
   6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
   8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
   2. Install 110-style IDC termination hardware unless otherwise indicated.
   3. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:
   1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

E. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

3.3 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
   1. Class 1 remote-control and signal circuits, No 14 AWG.
   2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12 AWG.

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section “Penetration Firestopping.”

3.6 GROUNDING

B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section “Grounding and Bonding for Electrical Systems.”

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section “Identification for Electrical Systems.”

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:
   1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
   2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.
      a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in “Test Instruments (Normative)” Annex, complying with measurement accuracy specified in “Measurement Accuracy (Informative)” Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 260523
SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes grounding and bonding systems and equipment, plus the following special applications:
   1. Underground distribution grounding.
   2. Ground bonding common with lightning protection system.
   3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Test wells.
   2. Ground rods.
   3. Ground rings.
B. Qualification Data: For testing agency and testing agency's field supervisor.
C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For grounding to include in operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
         1) Test wells.
         2) Ground rods.
         3) Ground rings.
      b. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.
         1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
         2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE
A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with UL 467 for grounding and bonding materials and equipment.
2.2 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. Advanced Lightning Technology, Ltd.
2. Burndy; Part of Hubbell Electrical Systems.
3. Dossert; AFL Telecommunications LLC.
4. ERICO International Corporation.
5. Fushi Copperweld Inc.
6. Galvan Industries, Inc.; Electrical Products Division, LLC.
7. Harger Lightning & Grounding.
8. ILSCO.
10. Robbins Lightning, Inc.
12. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction. Refer to Section 260519 for insulation requirements.

B. Bare Copper Conductors:

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Pre-drilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, minimum 12 inches in length, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.

J. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
K. Water Pipe Clamps:
1. Mechanical type, two pieces with stainless-steel bolts.
   b. Listed for direct burial.
2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches below grade.

C. Grounding Bus: Install in telecommunications equipment rooms, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 96 inches above finished floor unless otherwise indicated.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with transformers by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated. 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any. 2. Use exothermic welds for all below-grade connections. 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover. 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit. 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts. 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment. 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping: 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end. 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector. 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. 1. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

J. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible. 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series. 2. Make connections with clean, bare metal at points of contact. 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer’s written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Make tests at ground rods before any conductors are connected.
   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   2. Pad-Mounted Equipment: 5 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526
SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Steel slotted support systems.
   2. Conduit and cable support devices.
   3. Support for conductors in vertical conduit.
   4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
   5. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame Rating: Class 1.
   2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Allied Tube & Conduit; a part of Atkore International.
      b. B-line, an Eaton business.
      c. ERICO International Corporation.
      d. Flex-Strut Inc.
      e. Gripple Inc.
      f. GS Metals Corp.
      g. G-Strut.
      h. Haydon Corporation.
      i. Metal Ties Innovation.
      j. MIRO Industries, Inc.
      k. Thomas & Betts Corporation; A Member of the ABB Group.
      l. Unistrut; Part of Atkore International.
      m. Wesanco, Inc.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Material for Channel, Fittings, and Accessories: Galvanized steel
   4. Channel Width: Selected for applicable load criteria.
   5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel or malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) Hilti, Inc.
         2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) B-line, an Eaton business.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti, Inc.
         4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All-steel springhead type.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA 1.
   2. NECA 101
   3. NECA 105.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.
3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
   6. To Light Steel: Sheet metal screws.
   7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Touchup: Comply with requirements in Section 099113 "Exterior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529
SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Metal conduits and fittings.
   2. Nonmetallic conduits and fittings.
   3. Metal wireways and auxiliary gutters.

B. Related Requirements:
   1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
   2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, handholes, and underground utility construction.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
   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. AFC Cable Systems; a part of Atkore International.
      b. Allied Tube & Conduit; a part of Atkore International.
      c. Anamet Electrical, Inc.
      d. Calconduit.
      e. Electri-Flex Company.
      f. NEC, Inc.
      g. Picoma Industries, Inc.
      h. Republic Conduit.
      i. Southwire Company.
      j. Western Tube and Conduit Corporation.
      k. Wheatland Tube Company.
   2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. GRC: Comply with ANSI C80.1 and UL 6.
   4. EMT: Comply with ANSI C80.3 and UL 797.
   5. FMC: Comply with UL 1; zinc-coated steel.
   6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. AFC Cable Systems; a part of Atkore International.
      b. Allied Tube & Conduit; a part of Atkore International.
      c. Anamet Electrical, Inc.
d. Calconduit.
e. Electri-Flex Company.
f. NEC, Inc.
g. NewBasis.
h. O-Z/Gedney; a brand of Emerson Industrial Automation.
i. Republic Conduit.
j. Southwire Company.
k. Thomas & Betts Corporation; A Member of the ABB Group.
l. Topaz Electric; a division of Topaz Lighting Corp.
m. Western Tube and Conduit Corporation.
n. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Fittings for EMT:
   a. Material: Steel.
   b. Type: Compression.
6. Expansion Fittings: Steel, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

C. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Arnco Corporation.
      b. CANTEX INC.
      c. CertainTeed Corporation.
      d. Condux International, Inc.
      e. FRE Composites.
      f. Kraloy.
      g. Lamson & Sessions.
      h. Niedax Inc.
   2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

B. Nonmetallic Fittings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Arnco Corporation.
      b. CANTEX INC.
      c. CertainTeed Corporation.
      d. Condux International, Inc.
      e. FRE Composites.
      f. Kraloy.
      g. Lamson & Sessions.
      h. Niedax Inc.
   2. Fittings, General: Listed and labeled for type of conduit, location, and use.
   3. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
   4. Solvents and Adhesives: As recommended by conduit manufacturer.
   5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Adalet.
   3. EGS/Appleton Electric.
   5. FSR Inc.
   6. Hoffman; a brand of Pentair Equipment Protection.
   8. Milbank Manufacturing Co.
  10. Oldcastle Enclosure Solutions.
  12. RACO; Hubbell.
  13. Spring City Electrical Manufacturing Company.
  14. Thomas & Betts Corporation; A Member of the ABB Group.
  15. Topaz Electric; a division of Topaz Lighting Corp.
  16. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

E. Luminaire Outlet Boxes: Non-adjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep, unless noted otherwise.

J. Gangable boxes are prohibited.
K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, unless indicated otherwise, with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:
   1. NEMA 250, Type 1, unless indicated otherwise, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC.
   2. Concealed Conduit, Aboveground: GRC.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed and Subject to Physical Damage: GRC. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   4. Damp or Wet Locations: GRC.
   5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel institutional kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
   3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

M. Stub-Ups to Above Recessed Ceilings:
   1. Use EMT or RMC for raceways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

S. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

U. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

V. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

X. Expansion-Joint Fittings:
1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations.

Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a rain-tight connection between box and cover plate or supported equipment and box.

BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

CC. Locate boxes so that cover or plate will not span different building finishes.

DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING
A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION
A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533
SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
   2. Grout.
   3. Silicone sealants.

B. Related Requirements:
   1. Section 078413 “Penetration Firestopping” for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For paints and coatings, indicating VOC content.
   2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
   2. Cast-Iron Pipe Sleeves: Cast or fabricated “wall pipe,” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Rectangular Openings:
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 GROUT

A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have a VOC content of 420 g/L or less.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe 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.

END OF SECTION 260544
SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Color and legend requirements for raceways, conductors, and warning labels and signs.
   2. Labels.
   4. Tapes.
   5. Tags.
   7. Cable ties.
   8. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

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

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.


C. Comply with ANSI Z535.4 for safety signs and labels.

D. Comply with NFPA 70E and Section 260573.19 “Arc-Flash Hazard Analysis” requirements for arc-flash warning labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.

2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

3. Colors for 480/277-V Circuits:
   b. Phase B: Orange.
   c. Phase C: Yellow.


C. Warning Label Colors:
   1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: “DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES.”
   2. Workspace Clearance Warning: “WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES.”

E. Equipment Identification Labels:
   1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. Champion America.
      c. emedco.
      d. Grafoplast Wire Markers.
      e. HellermannTyton.
      f. LEM Products Inc.
      g. Marking Services, Inc.
      h. Panduit Corp.
      i. Seton Identification Products.

B. Snap-around Labels: Slit, pre-tensioned, flexible, pre-printed, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. HellermannTyton.
      c. Marking Services, Inc.
      d. Panduit Corp.
      e. Seton Identification Products.

   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. A'n D Cable Products.
      b. Brady Corporation.
      c. Brother International Corporation.
      d. emedco.
      e. Grafoplast Wire Markers.
      f. Ideal Industries, Inc.
      g. LEM Products Inc.
      h. Marking Services, Inc.
      i. Panduit Corp.
j. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A'n D Cable Products.
   b. Brady Corporation.
   c. Brother International Corporation.
   d. emedco.
   e. Grafoplast Wire Markers.
   f. HellermannTyton.
   g. Ideal Industries, Inc.
   h. LEM Products Inc.
   i. Marking Services, Inc.
   j. Panduit Corp.
   k. Seton Identification Products.

   2. Minimum Nominal Size:
      a. 1-1/2 by 6 inches for raceway and conductors.
      b. 3-1/2 by 5 inches for equipment.
      c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pre-tensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brady Corporation.
   b. HellermannTyton.
   c. Marking Services, Inc.
   d. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brady Corporation.
   b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Brady Corporation.
   b. Ideal Industries, Inc.
   c. LEM Products Inc.
   d. Marking Services, Inc.
   e. Reef Industries, Inc.
   f. Seton Identification Products.

2. Tape:
   a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape shall be permanent and shall not be damaged by burial operations.
   c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:
   b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
c. Inscriptions for Orange-Colored Tapes: “TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE”.

4. Tag:
   a. Detectable three-layer laminate, alkali and acid resistant, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; red colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   b. Width: 6 inches.
   c. Overall Thickness: 5 mils.
   d. Foil Core Thickness: 0.35 mil.
   e. Weight: 28 lb/1000 sq. ft.
   f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

2.6 TAGS

A. Write-on Tags:
   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. Carlton Industries, LP.
      b. LEM Products Inc.
      c. Seton Identification Products.
   2. Polyester Tags: [0.010 inch] [0.015 inch] <Insert dimension> thick, with corrosion-resistant grommet and cable tie for attachment.
   3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.7 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Brady Corporation.
      b. Carlton Industries, LP.
      c. emedco.
      d. Marking Services, Inc.
   2. Engraved legend.
   3. Thickness:
      a. For signs up to 20 sq. in., minimum 1/16 inch thick.
      b. For signs larger than 20 sq. in., 1/8 inch thick.
      c. Engraved legend with white letters on a dark gray background.
      d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
      e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

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. HellermannTyton.
   2. Ideal Industries, Inc.
   3. Marking Services, Inc.
   4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.
D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.


I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."

L. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Labels:
   1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

R. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench [or concrete envelope] exceeds 16 inches overall.
   2. Install underground-line warning tape for direct-buried cables and cables in raceways.

S. Write-on Tags:
   1. Place in a location with high visibility and accessibility.

T. Laminated Acrylic or Melamine Plastic Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

U. Cable Ties: General purpose, for attaching tags, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120 V to Ground: Identify with self-adhesive raceway labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
H. Conduits to Be Extended in the Future: Attach write-on tags to conduits and list source.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

J. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
      a. Power-transfer switches.


N. Operating Instruction Signs: Self-adhesive labels.

O. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

P. Equipment Identification Labels:
   1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
   2. Outdoor Equipment: Laminated acrylic or melamine sign.
   3. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Switchboards.
      e. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
      f. Emergency system boxes and enclosures.
      g. Enclosed switches.
      h. Enclosed circuit breakers.
      i. Enclosed controllers.
      j. Variable-speed controllers.
      k. Push-button stations.
      l. Power-transfer equipment.
      m. Contactors.
      n. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553
SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies, and the setting of these devices.
   1. Include coordination of series-rated devices where series rating is specified in other sections and where indicated on Drawings.
   2. The AIC ratings indicated on the Drawings are preliminary and will be finalized based on the results of the fault current study. Device ratings for furnished equipment shall be as required by the results of the fault current study at no additional cost.
   3. Overcurrent protective device coordination study must be completed and approved prior to ordering equipment so that device ratings can be coordinated and modified as required. Product data submittal for switchboards and panelboards and overcurrent protection devices will not be returned until coordination study has been reviewed by the Engineer.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Section 260500 “Common Work Results for Electrical” for general requirements and related documents that apply to this section.

B. Section 262413 “Switchboards”.

C. Section 262200 “Low Voltage Transformers”.

D. Section 262416 “Panelboards”.

E. Section 262816 “Enclosed Switches Circuit Breakers”.

F. Section 263213 “Engine Generators”.

G. Section 263600 “Transfer Switches”.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals:
   1. Coordination-study input data, including completed computer program input data sheets.
   2. Coordination-study report.
   3. Equipment evaluation report.
   4. Arc-Flash Hazard Analysis.
   5. Setting report.

E. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section “General Electrical Requirements”:
   1. Accurately record on the One-Line Diagram actual ratings and settings for all overcurrent devices, both adjustable and non-adjustable, including all changes made during construction, due to the study, or both.

1.4 QUALITY ASSURANCE
A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 399 for general study procedures.

D. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

E. Comply with IEEE 1584 and NFPA 70E for arc-flash hazard calculations.

PART 2 - PRODUCTS AND MATERIALS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:
   1. CYME International, Inc.
   2. EDSA Micro Corporation.
   3. Electrical Systems Analysis, Inc.
   4. SKM Systems Analysis, Inc.

C. Computer Software Developer: Subject to compliance with requirements, provide computer software program by SKM.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.
   1. Zero-Sequence current.
   2. Arcing faults.
   3. Simultaneous faults.
   4. Explicit negative sequence.
   5. Mutual coupling of zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Coordinate with all devices and equipment within the system and provide the appropriate settings for all adjustable circuit breaker settings.

B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.
C. Fault current study and coordination study shall be performed prior to the final submittals for any piece of electrical equipment which has an AIC rating or an over-current protective device so that the correct equipment is ordered for the project conditions.

D. Arc Flash Study shall be performed after field coordinated conductor lengths have been determined and after the utility company confirms the available fault current. The coordination study with all device settings shall be submitted with the Arc Flash Study. The goal is to minimize the arc flash hazard while maintaining coordination and selectivity. For the components of the emergency and legally required standby system components, full selectivity shall be maintained.

E. Complete fault current, coordination and arc flash study shall be completed and reviewed prior to ordering equipment so that device ratings can be coordinated and modified as required. Product data submittal for electrical equipment will not be returned until coordination study has been reviewed by the Engineer.

F. Short circuit current rating for electrical equipment (including but not limited to switchboards, distribution panelboards, panelboards, etc): Short circuit rating indicated on the Drawings is preliminary, the actual ratings shall be as determined by the results of the studies required by this Section. Coordinate final settings and short circuit values with equipment supplier prior to development of shop drawing submittals.

G. Overcurrent protective device coordination study must be completed and approved prior to ordering equipment so that device ratings can be coordinated and modified as required. Product data submittal for switchboards and panelboards and overcurrent protection devices will not be returned until coordination study has been reviewed by the Engineer.

H. Selective coordination study shall be provided for elevators, emergency systems, legally required standby systems, and critical operations power systems in accordance with the applicable edition of the NEC.

3.2 SYSTEM COMPONENTS TO BE INCLUDED IN STUDIES

A. Study shall begin with the utility overcurrent device(s) serving the Project and end at the last branch circuit overcurrent protective device.

B. Components include, but are not limited to:
   1. Switchgear
   2. Switchboards
   3. Distribution Panelboards
   4. Panelboards
   5. Automatic Transfer Switches
   6. Motor Control Centers
   7. Chiller Controllers
   8. Air Handling Equipment
   9. Rooftop HVAC equipment
  10. Elevator controllers
  11. Generators

3.3 POWER SYSTEM DATA FOR STUDIES

A. Gather and tabulate the following input data to support studies:
   1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Impedance of utility service entrance.
   3. Electrical distribution system diagram showing the following:
      a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
      b. Circuit-breaker and fuse-current ratings and types.
      c. Relays and associated power and current transformer ratings and ratios.
      d. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
      e. Generator kilovolt amperes, size, voltage, and source impedance.
      f. Cables. Indicate conduit material, sizes of conductors, conductor insulation, and length.
      g. Busway ampacity and impedance.
      h. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:
   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Magnetic inrush current overload capabilities of transformers.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Ratings, types, and settings of utility company's overcurrent protective devices.
   e. Special overcurrent protective device settings or types stipulated by utility company.
   f. Time-current-characteristic curves of devices indicated to be coordinated.
   g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
   i. Panelboards, switchboards, motor-control center ampacity, and interrupting ratings in amperes rms symmetrical.

3.4 FAULT-CURRENT STUDY

A. Source Impedance: Utility company's fault-current contribution as indicated.

B. Study electrical distribution system from normal and alternate power sources throughout the new and existing portions of the electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Comply with and IEEE 242 recommendations for fault currents and time intervals.

E. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:
   2. Low-Voltage Fuses: IEEE C37.46.

F. Study Report:
   1. Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report.
   2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
   3. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault-current values for 3-phase, 2-phase, and phase-to-ground faults.

G. Overcurrent protective Device Equipment: Protective devices shall have a short circuit interrupting rating as determined by the fault study.

H. Equipment Evaluation Report: Prepare a report on the adequacy of new and existing overcurrent protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties.

3.5 COORDINATION STUDY

A. Provide coordination study of the new and existing portions of the electrical distribution system for Project and use approved computer software program to calculate values.

B. Perform coordination study and prepare a written report using the results of fault-current study and approved computer software program. Comply with IEEE 399.

C. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.

D. Comply with and IEEE 242 recommendations for fault currents and time intervals.
E. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
   a. Self-cooled, full-load current or forced-air-cooled full-load current, whichever is specified for that transformer.
   b. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.

F. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.

H. Selective Coordination: The study shall include determining the appropriate circuit breaker type and frame size required for the application and determining the associated settings to achieve selective coordination.
1. Overcurrent protective devices serving elevators, emergency systems, legally required standby systems, and critical operations power systems shall be selectively coordinated in accordance with the applicable edition of the NEC.
2. In healthcare facilities, overcurrent protective devices serving the essential electrical system shall be coordinated for the period of time that a fault's duration extends beyond 0.1 second.

I. Ground Fault Settings: Adjustable ground fault settings shall be coordinated to allow the highest settings allowable to minimize nuisance trips and shall be fully selective such that the second level device shall open on ground faults on the load side of the second level device. Devices in the first level of ground fault protection shall have the maximum settings allowed by NEC Article 230.95(A). Devices in the second level of ground fault protection settings shall be coordinated to achieve the highest possible setting while maintaining fully selective coordination with a minimum six-cycle separation between the first and second level ground-fault tripping bands in accordance with NEC Article 517.17(B).

J. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
   c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
   d. Fuse-current rating and type.
   e. Ground-fault relay-pickup and time-delay settings.
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between series devices, including power utility company's upstream devices. Show the following specific information:
   a. Device tag.
   b. Voltage and current ratio for curves.
   c. Three-phase and single-phase damage points for each transformer.
   d. No damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum fault-current cutoff point.
3. Completed data sheets for setting of overcurrent protective devices.

3.6 OVERCURRENT PROTECTIVE DEVICE SETTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to set and adjust overcurrent protective devices within equipment.

B. Testing: Perform the following device setting and prepare reports:
1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
   a. Verify that overcurrent protective devices meet parameters used in studies.
   b. Adjust devices to values listed in study results.
   c. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 10.7 and 10.8 in NETA ATS.
3.7   ARC-FLASH HAZARD ANALYSIS

A. Determine arc-flash incident energy levels and flash protection boundary distances based on the results of the Short-Circuit and Coordination studies. Perform the analysis under worst-case arc-flash conditions for all modes of operation.

B. Identify all locations and equipment to be included in the arc-flash hazard analysis.

C. Identify the possible system operating modes including tie-breaker positions, and parallel generation.

D. Calculate the arcing fault current flowing through each branch for each fault location.

E. Determine the time required to clear the arcing fault current using the protective device settings and associated trip curves.

F. Select the working distances based on system voltage and equipment class.

G. Calculate the incident energy at each fault location at the prescribed working distance.

H. Determine the hazard/risk category (HRC) for the estimated incident energy.

I. Calculate the flash protection boundary at each fault location.

J. Document the assessment in reports and one-line diagrams.

K. Provide labels and affix to each piece of equipment analyzed. Label shall show the calculated incident energy and hazard/risk category for the calculated incident energy.

L. Results of the arc-flash study shall be summarized in a final report containing the following:
   1. Include a copy of the facility one-line in the report.
   2. Basis, method of hazard assessment, description, purpose, scope, and date of the study.
   3. Tabulations of the data used to model the system components and a corresponding one-line diagram.
   4. Descriptions of the scenarios evaluated and identification of the scenario used to evaluate equipment ratings.
   5. Tabulations of equipment incident energies, hazard risk categories, and flash protection boundaries. The tabulation shall identify and clearly note equipment that exceeds allowable incident energy ratings.
   6. Required arc-flash labeling and placement of labels.
   7. Conclusions and recommendations.

END OF SECTION 260573
SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting control devices:
   1. Time switches.
   2. Outdoor photoelectric switches.
   3. Indoor occupancy sensors.
   4. Outdoor motion sensors.
   5. Lighting contactors.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.
C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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:
   1. Area Lighting Research, Inc.; Tyco Electronics.
   2. Grasslin Controls Corporation; a GE Industrial Systems Company.
   3. Intermatic, Inc.
   5. Lightolier Controls; a Genlyte Company.
   6. Lithonia Lighting; Acuity Lighting Group, Inc.
   8. Square D; Schneider Electric.
   9. TORK.
   10. Touch-Plate, Inc.
   11. Watt Stopper (The).

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
   1. Contact Configuration: DPDT.
   2. Contact Rating: 30-A inductive or resistive, 240-V ac.
   3. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
   4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
   5. Astronomic Time: Selected channels.
   6. Battery Backup: For schedules and time clock.

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:
   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.
7. Square D; Schneider Electric.
8. TORK.
9. Touch-Plate, Inc.
10. Watt Stopper (The).

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

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:
1. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. RAB Lighting, Inc.
6. Sensor Switch, Inc.
7. TORK.
8. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

2.4 LIGHTING CONTACTORS

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:
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
4. GE Industrial Systems; Total Lighting Control.
5. Grasslin Controls Corporation; a GE Industrial Systems Company.
6. Hubbell Lighting.
7. Lithonia Lighting; Acuity Lighting Group, Inc.
9. Square D; Schneider Electric.
10. TORK.
11. Touch-Plate, Inc.
12. Watt Stopper (The).

B. Description: Electrically operated and mechanically held, combination type with fusible switch, complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
   2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
   3. Enclosure: Comply with NEMA 250.
   4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
   1. Monitoring: On-off status; one BMS point shall be included for each lighting contactor unless noted otherwise.
   2. Control: On-off operation; one BMS point shall be included for each lighting contactor unless noted otherwise.

2.5 EMERGENCY SHUNT RELAY

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. Lighting Control and Design, Inc.
   2. Wattstopper.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
   1. Coil Rating: 120 V.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.
3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.

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.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to evaluate sensor layouts prior to installation, and to test and inspect components, assemblies, and equipment installations, including connections.

B. 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 sensitivity and time delay settings as required to ensure correct operation.

C. Lighting control devices that fail tests and inspections are defective work.

D. Prepare test and inspection reports.

END OF SECTION 260923
SECTION 260943 - DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Digital Lighting Controls
   2. Relay Panels
   3. Emergency Lighting Control (if applicable)

B. Related Sections:
   2. Section 262726 – Wiring Devices
   3. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section
   4. Electrical Sections, including wiring devices, apply to the work of this Section.

1.2 LIGHTING CONTROL APPLICATIONS

A. Provide a minimum application of lighting controls as follows:
   1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual-ON functionality in all spaces except toilet rooms, corridors where Automatic-ON occupancy sensors shall be provided. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan offices and training rooms. Refer to Occupancy/Vacancy sensor schedule on plans for exact model requirements.
   2. Daylit Areas – Provide daylight-responsive automatic control in Bistro area for all lighting fixtures within daylight zone. Daylight zone shall encompass all fixtures within 15ft of exterior windows.
      a. All luminaires within defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
      b. Provide smooth and continuous daylight dimming for areas with daylight control. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

1.3 SUBMITTALS

A. In addition to equipment cutsheet submittal requirements indicated in previous sections of this specification, provide the following:
   1. Show exact location of all digital devices, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans.
   2. Provide room/area details including devices and sequence of operation for the following areas, Bistro, Open Lobby Area and Board Room/Meeting Room.

1.4 QUALITY ASSURANCE

A. Manufacturer: Minimum 10 years experience in manufacture of lighting controls.

1.5 WARRANTY

A. Provide a five year limited manufacturer’s warranty on all room control devices.

1.6 MAINTENANCE

A. Spare Parts:
   1. Provide three spares of each product to be used for maintenance as listed below:
      - LMRC-101 On/Off Room Controller
      - LMRC-211 Dimming Room Controller
      - LMRC-212 Dimming Room Controller
      - LMRC-213 Dimming Room Controller
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Basis of design product: WattStopper Digital Lighting Management (DLM) or subject to compliance and prior
   approval with specified requirements of this section, one of the following alternate manufacturers:
   a. Leviton

2.2 GENERAL REQUIREMENTS

A. Unless noted otherwise in this specification section or on plan, each device shall be provided with RJ-45 ports for
   connection to DLM local network. Provide cord connections with strain relief.

2.3 SENSORS

A. Sensors shall be provided with calibration and pushbutton configuration for the following variables:

1. Sensitivity – 0-100% in 10% increments
2. Time delay – 1-30 minutes in 1 minute increments
3. Test mode – Five second time delay
4. Walk-through mode
5. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors
   are included in the DLM local network.

B. Remote programming through handheld configuration tool and control by remote personal controls shall be
   required.

C. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.

D. Manual override of controlled loads.

E. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH
   memory within the wall switch sensor itself. Memory shall have an expected life of no less than 5 years.

F. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local
   network. No additional configuration will be required.

2.4 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in up to 8 button configurations. Wall switches shall include the
   following features:

1. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button
   replacement may be completed without removing the switch from the wall.
2. Configuration LED on each switch that blinks to indicate data transmission.
3. Dimming switches shall include LEDs to indicate load levels using steps.
4. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH
   memory within the wall switch itself. Memory shall have an expected life of no less than 5 years.

B. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local
   network. No additional configuration shall be required to achieve multi-way switching.

C. The following switch attributes may be changed or selected using a wireless configuration tool:

1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice
   versa).
2. Individual button function may be configured to Toggle, On only or Off only.
3. Individual scenes may be locked to prevent unauthorized change.
4. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button
   may be bound to multiple loads.

2.5 DIGITAL PARTITION CONTROLS
A. Partition controls shall enable manual coordination of lighting controls in flexible spaces with up to three moveable walls by reconfiguring the connected digital switches and occupancy sensors.

B. Four-button low voltage pushbutton switch for manual control.
   1. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
   2. Configuration LED on each switch that blinks to indicate data transmission.
   3. Each button represents one wall; LED lit button indicates status.

C. Contact closure interface for automatic control via input from limit switches on movable walls (by others).
   1. Operates on Class 2 power supplied by DLM local network.
   2. Includes 24VDC output and four input terminals for maintained third party contract closure inputs.
   3. Four status LEDs under hinged cover indicate if walls are open or closed.

2.6 DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring.
   1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.

B. Digital daylighting sensors shall include the following features:
   1. The sensor’s internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode’s spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
   2. Sensor light level range shall be from 1-6,500 footcandles (fc).
   3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
   4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the “ON Setpoint” and the “OFF Setpoint” that will prevent the lights from cycling excessively after they turn off.
   5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
   6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
   7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
   8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, raise lighting levels for a selectable period of time or cycle of occupancy.
   9. Configuration LED status light on device that blinks to indicate data transmission.
  10. Status LED indicates test mode, override mode and load binding.
  11. Recessed switch on device to turn controlled load(s) ON and OFF.
  12. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, or backbox. Provide photosensor compatible with mounting material (up to 1.25” thick. Mounting brackets are compatible with J boxes and wall mounting.
  13. Any load or group of loads in the room can be assigned to a daylighting zone
  14. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 5 years.

C. Closed loop digital photosensors shall include the following additional features:
   1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
   2. Automatic self-calibration, initiated from the photosensor or a wireless configuration tool.
   3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.

D. Open loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.
2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
3. Each of the three discrete daylight zones can include any non-overlapping group of loads in the room.

2.7 ROOM CONTROLLERS

A. Digital controllers for lighting and plug loads automatically bind the room loads to the connected devices in the space without the use of any tools. Room load controllers shall be provided to match the room lighting control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers. The control units will include the following features:
1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
2. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID’s from highest to lowest.
3. Device Status LEDs to indicate:
   a. Data transmission
   b. Device has power
   c. Status for each load
   d. Configuration status
4. Each load shall be configurable to operate in the following sequences based on occupancy:
   a. Auto-on/Auto-off (Follow on and off)
   b. Manual-on/Auto-off (Follow off only)
5. All wiring shall be UL 2043 plenum rated
6. Manual override and LED indication for each load
7. Dual voltage 120/277 VAC, 60 Hz. 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming). Separate controllers shall be provided for 120 volt loads and 277 volt loads
8. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 5 years.

B. On/Off Room Controllers shall include:
1. One or two relay configuration
2. Efficient 150 mA switching power supply

C. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
2. Multiple relay configurations
3. One dimming output per relay
   a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting.
   b. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
   c. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
   d. Calibration and trim levels must be set per output channel.
4. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
5. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
6. Override button for each load provides the following functions:
   a. Press and release for on/off control
   b. Press and hold for dimming control

2.8 DLM LOCAL NETWORK (Room Network)
A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.

B. Features of the DLM local network include:
1. Simple replacement of any device in the network with a standard unit without requiring commissioning, configuration or setup.
2. Communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2.9 CONFIGURATION TOOLS

A. A wireless configuration tool facilitates optional customization of DLM local networks using infrared communications.

B. Features and functionality of the wireless configuration tool shall include but not be limited to:
1. Communication with DLM IR-enabled devices within a range of approximately 30 feet.
2. Must be able to read and modify parameters for room controllers, occupancy sensors, wall switches, daylighting sensors, network bridges and relay panels, and identify room devices by type and serial number.
3. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
4. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.

2.10 EMERGENCY LIGHTING TRANSFER DEVICES

A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

B. WattStopper Product Numbers: ELCU-100, ELCU-200. Alternate manufacturers include Bodine.

PART 3 - EXECUTION

3.1 CONTRACTOR INSTALLATION AND SERVICES

A. All line voltage connections to be tagged to indicate circuit and switched legs.

B. Contractor to install all room/area devices using manufacturer’s factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer’s specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

C. Before start up, contractor shall test all devices to ensure proper communication.

D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied. Sensors located in Nest area shall be programmed for time delay of 30 minutes.

E. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner’s requirements. Provide a detailed report to the Architect / Owner of post start-up activity.
3.2 FACTORY SERVICES

A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.

B. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

END OF SECTION 260943
SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

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: Distribution, dry-type transformers rated 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
   2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For transformers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
1.8 COORDINATION

A. Coordinate layout and installation of transformers and components with other electrical equipment. Coordinate electrical equipment layout and installation with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances, dedicated equipment spaces, and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. 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 the following:
   1. Basis of Design:
      a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. Approved Manufacturers: Shall furnish product with equivalent as the specified basis of design manufacturer and model series.
      b. Square D; by Schneider Electric. – EX series

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Transformers Rated 15 kVA and Larger: Comply with 2016 DOE (10 CFR 431) energy-efficiency levels.

D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

E. Comply with NEC 450.9 Ventilation requirements.

F. Comply with NEC 450.10 Grounding requirements.

G. Comply with NEC 450.11 Markings requirements.

H. Comply with NEC 450.12 Terminal wiring space requirements.

I. Transformers shall be constructed with a space saving design to allow transformer installation within 0.5 inch of the wall.

J. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

K. Coils: Continuous windings without splices except for taps.
   1. Internal Coil Connections: Brazed or pressure type.
   2. Coil Material: Aluminum.

L. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

M. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.
2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated.
   1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
   2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.

D. Transformer Enclosure Finish: Comply with NEMA 250.
   1. Finish Color: Gray.

E. Taps for Transformers 3 kVA and Smaller: None.

F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

H. Insulation Class, Smaller than 30 kVA: 220 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

J. Wall Brackets: Manufacturer's standard brackets.

K. Fungus Proofing: Permanent fungicidal treatment for coil and core.

L. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
   1. 30 kVA and Less: 40 dBA.
   2. 31 to 75 kVA: 45 dBA. 51 to 150 kVA: .
   3. 76 to 225 kVA: 50 dBA. 301 to 500 kVA: .
   4. 226 to 300 kVA: 55 dBA. 751 to 1000 kVA: .
   5. 301 to 750 kVA: 60 dBA.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
   1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
   2. Ratio tests at the rated voltage connections and at all tap connections.
   3. Phase relation and polarity tests at the rated voltage connections.
   4. No load losses, and excitation current and rated voltage at the rated voltage connections.
   5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
   6. Applied and induced tensile tests.
   7. Regulation and efficiency at rated load and voltage.
   8. Insulation Resistance Tests:
      a. High-voltage to ground.
      b. Low-voltage to ground.
      c. High-voltage to low-voltage.
   9. Temperature tests.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer’s written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
   1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
   2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
   1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.
C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.


3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200
SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.
B. GFCI: Ground-fault circuit interrupter.
C. GFEP: Ground-fault equipment protection.
D. HID: High-intensity discharge.
E. MCCB: Molded-case circuit breaker.
F. SPD: Surge protective device.
G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.
   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   3. SPD Manufacturer’s catalog data, technical information and specifications on equipment proposed for use.
   4. Documentation stating that the Surge Protection Device is listed by UL to UL1449 3rd Edition, category code VZCA.
   5. Test report validating the repetitive surge test was performed by the SPD manufacturer.
   6. SPD warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.
   5. Short-circuit current rating of panelboards and overcurrent protective devices.
   6. Include evidence of NRTL listing for series rating of installed devices.
   7. Include evidence of NRTL listing for SPD as installed in panelboard.
   8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   9. Include wiring diagrams for power, signal, and control wiring.
   10. Key interlock scheme drawing and sequence of operations.
   11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of
overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the
coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and
maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include
the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows
adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and
identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Provide spare breakers as indicated on the Drawings.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than
three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but
no fewer than three of each size and type.
5. Insert extra materials.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W
per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

A. Environmental Limitations:
1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is
complete and dry, work above panelboards is complete, and temporary HVAC system is operating and
maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the
construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.11 COORDINATION

A. Coordinate layout and installation of panelboards and components with actual dimension of furnished equipment.
Maintain space for future panels and equipment indicated on the Drawings. Coordinate requirements with other
divisions to maintain specified requirements.
B. Coordinate layout and installation of panelboards and components with other electrical equipment. Coordinate
electrical equipment layout and installation with other construction that penetrates walls or is supported by them,
including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance
requirements, and adjacent surfaces. Maintain required workspace clearances, dedicated equipment spaces, and
required clearances for equipment access doors and panels. Coordinate requirements with other divisions to
maintain specified requirements.

C. Panelboard short circuit current rating: Fully rated to interrupt symmetrical short-circuit current available at
terminals. Short circuit rating indicated on the Drawings is preliminary, the actual ratings shall be as determined by
the manufacturer’s overcurrent protective device study. Refer to section “Overcurrent Protective Device
Coordination” for additional information.

D. Overcurrent protective device coordination study must be completed and approved prior to ordering equipment so
that device ratings can be coordinated and modified as required. Product data submittal for switchboards and
panelboards and overcurrent protection devices will not be returned until coordination study has been reviewed by
the Engineer.

1.12 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or
workmanship within specified warranty period.
1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in
materials or workmanship within specified warranty period.
1. SPD Warranty Period: Fifteen years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Basis of Design:
   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. Approved Manufacturers: Shall furnish product with equivalent as the specified basis of design manufacturer
   and model series.
   b. Square D; by Schneider Electric

B. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16
"Seismic Controls for Electrical Systems."

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including
clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum
dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing
agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for
   flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. **Hinged Front Cover:** Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. **Finishes:**
   a. **Panels and Trim:** Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. **Back Boxes:** Galvanized steel.
   c. **Fungus Proofing:** Permanent fungicidal treatment for overcurrent protective devices and other components.

H. **Incoming Mains:**
1. **Location:** Top or Bottom.

I. **Phase, Neutral, and Ground Buses:**
1. **Material:** Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
   a. Plating shall run entire length of bus.
   b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. **Equipment Ground Bus:** Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. **Full-Sized Neutral:** Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

J. **Conductor Connectors:** Suitable for use with conductor material and sizes.
1. **Material:** Tin-plated aluminum.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. **Size:** Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. **Main and Neutral Lugs:** Compression or Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. **Ground Lugs and Bus-Configured Terminators:** Compression Mechanical type, with a lug on the bar for each pole in the panelboard.
6. **Feed-Through Lugs:** Compression or Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. **Subfeed (Double) Lugs:** Compression or Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

K. **NRTL Label:** Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

L. **Future Devices:** Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

M. **Panelboard Short-Circuit Current Rating:** Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity. Short circuit rating indicated on the Drawings is preliminary, the actual ratings shall be as determined by the manufacturer's overcurrent protective device study. Refer to section “Overcurrent Protective Device Coordination” for additional information.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

N. **Selective Coordination:** The overcurrent protective devices provided for elevators, emergency systems, legally required standby systems, and critical operations power systems shall be selectively coordinated in accordance with the applicable edition of the NEC.
1. Provide panelboards with overcurrent protective devices as required to achieve selective coordination.
2. The trip rating on the drawings does not reflect the frame size. Provide circuit breaker type and frame size as required for the application.
3. Coordinate the breaker type and frame size required with the overcurrent protective device coordination study.
2.2 SURGE PROTECTION DEVICES

A. Factory installed as an integral part of indicated panelboards.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advanced Protection Technologies Inc. (APT).
   2. Current Technology, Inc.
   3. Square D; by Schneider Electric.
   5. Siemens Energy & Automation, Inc.

C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
   1. SPDs with the following features and accessories:
      a. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
      b. Indicator light display for protection status.
      c. Surge counter.

D. “Tested Single Pulse Surge Current/Repetitive Surge Current Capacity Rating” per mode shall be the minimum as follows:
   1. L-N: 100,000 amps/7,000 Impulses
   2. N-G: 100,000 amps/7,000 Impulses
   3. L-G: 100,000 amps/7,000 Impulses
   4. L-L: 200,000 amps/14,000 Impulses
   5. Per Phase: 200,000 amps/14,000 Impulses

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 1000 V for 480Y/277 V.
   2. Line to Ground: 1200 V for 480Y/277 V.
   3. Line to Line: 2000 V for 480Y/277 V.

F. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 600 V for 208Y/120 V.
   2. Line to Ground: 600 V for 208Y/120 V.
   3. Line to Line: 1000 V for 208Y/120 V.

G. SCCR: Equal or exceed 100 kA.

H. Nominal Rating: 20 kA.

I. Comply with UL 1283.

2.3 POWER DISTRIBUTION PANELBOARDS

A. Basis of Design:
   1. Square D; by Schneider Electric. – I-Line series

B. Panelboards: NEMA PB 1, distribution type.

C. Mains: Circuit breaker or Lugs only as indicated on the Drawings.


E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

F. Refer to section 262816 “Enclosed Switches and Circuit Breakers” for molded-case circuit breaker requirements.
2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis of Design:
   1. Square D; by Schneider Electric. – NQ and NF series

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as indicated.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Square D; by Schneider Electric.
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Refer to section 262816 “Enclosed Switches and Circuit Breakers” for additional molded-case circuit breaker requirements.
   2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
   3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).

6. MCCB Features:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
   f. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
   g. Multi pole units enclosed in a single housing with a single handle.

7. MCCB Accessories, where indicated:
   a. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   b. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
   c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
   d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   e. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
   f. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
   g. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
   h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position as indicated.
   i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
   1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
   1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:
   1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount panelboard such that the operating handle of top-most switch or circuit breaker, in on position, is not higher than 79 inches above finished floor or grade.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Recessed panelboards
   1. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
   2. Provide spare 1” empty conduit for every 3-unused breaker spaces in panelboard. Conduits shall extend from panelboard up to accessible ceiling space adjacent to panelboard. If space is not available for required quantity of 1” conduits, provide 2” conduit from panelboard to minimum 18”x 18” x 8” deep pull box in accessible location above accessible ceiling adjacent to panelboard.
I. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.
   2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

K. Install filler plates in unused spaces.

L. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

M. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

N. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Perform optional tests. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
   1. Measure loads during period of normal facility operations.
   2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
   3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
   4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416
SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Standard-grade receptacles, 125 V, 20 A.
   2. USB receptacles.
   3. GFCI receptacles, 125 V, 20 A.
   4. Twist-locking receptacles.
   5. Pendant cord-connector devices.
   6. Cord and plug sets.
   7. Toggle switches, 120/277 V, 20 A.
   8. Occupancy sensors.
   9. Wall plates.
   10. Floor service fittings.
   11. Poke-through assemblies.

1.3 DEFINITIONS

A. BAS: Building automation system.
B. EMI: Electromagnetic interference.
C. GFCI: Ground-fault circuit interrupter.
D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
E. RFI: Radio-frequency interference.
F. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
2. Poke-Through, Fire-Rated Closure Plugs: One for every 10 floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Leviton is the preferred manufacturer for products.

B. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Comply with NFPA 70.

D. RoHS compliant.

E. Comply with NEMA WD 1.

F. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
   2. Devices shall comply with requirements in this Section.

G. Devices for Owner-Furnished Equipment:
   1. Receptacles: Match plug configurations.
   2. Cord and Plug Sets: Match equipment requirements.

H. Device Color:
   1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour/Legrand (Pass & Seymour).
   2. Description: Two pole, three wire, and self-grounding.
   3. Configuration: NEMA WD 6, Configuration 5-20R.
   4. Standards: Comply with UL 498 and FS W-C-596.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 15 A

A. Duplex Receptacles, 125 V, 15 A:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Eaton (Arrow Hart).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour/Legrand (Pass & Seymour).
   2. Description: Two pole, three wire, and self-grounding.
   3. Configuration: NEMA WD 6, Configuration 5-15R.
   4. Standards: Comply with UL 498 and FS W-C-596.
2.4 USB RECEPTACLES

A. Tamper-Resistant Duplex and USB Charging Receptacles:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.

3. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.

4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).

5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.


2.5 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with “Test” and “Reset” buttons and LED indicator light. Two pole, three wire, and self-grounding.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Type: Non-feed through.

5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with “Test” and “Reset” buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.

3. Configuration: NEMA WD 6, Configuration 5-15R.

4. Type: Non-feed through.

5. Standards: Comply with UL 498 and UL 943 Class A.

6. Marking: Listed and labeled as complying with NFPA 70, “Tamper-Resistant Receptacles” and “Receptacles in Damp or Wet Locations” articles.

2.6 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, with Ratings as Indicated on the Drawings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Configuration: NEMA WD 6, Configuration as indicated on the Drawings.


2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.
B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Eaton (Arrow Hart).
2. Hubbell Incorporated; Wiring Device-Kellems.
3. Leviton Manufacturing Co., Inc.

C. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.

D. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

E. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

F. Standards: Comply with FS W-C-596.

2.8 CORD REELS

A. Description: Cord and connector capable of retracting into housing, spring drive type, industrial grade.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
2. KH Industries.
3. Reelcraft.

C. Configuration: NEMA 5-20P power supply plug with fixed cord length. NEMA 5-20R connector with 50 foot retractable SJ cord and adjustable stop.

D. Housing: Steel, with manufacturer enamel finish. Provide with pivoting base.

2.9 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.10 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).
2. Standards: Comply with UL 20 and FS W-S-896.

B. Three-Way Switches, 120/277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).
2. Comply with UL 20 and FS W-S-896.
2.11 OCCUPANCY SENSORS

A. Wall Sensor Light Switch, Passive Infrared:
1. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Integral relay for connection to BAS.
6. Adjustable time delay as indicated on the Drawings.
7. Able to be locked to Manual-On mode.

2.12 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable in-use type cover.

2.13 FLOOR SERVICE FITTINGS

A. Flush-Type Floor Service Fittings (Type A):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Wiremold/Legrand, RFB4 series or comparable product by one of the following:
   a. Eaton.
   b. FSR.
   c. Hubbell.
   d. Thomas & Betts.
2. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
3. Compartments: Barrier separates power from voice and data communication cabling.
4. Service Plate and Cover: Rectangular, flanged, hinged, die-cast aluminum with satin finish, two side cable exit flaps, and no tile/carpet cutout. Finish color to be selected by Architect from standard color options.
5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated, quantity of two.
7. UL listed for scrub water exclusion.

2.14 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Wiremold/Legrand, 6AT series or comparable product by one of the following:
1. Eaton.
2. FSR.
3. Hubbell.
4. Thomas & Betts.

C. Standards: Comply with scrub water exclusion requirements in UL 514.

D. Service-Outlet Assembly: Flush type with two proprietary duplex receptacles and one gang with blank cover for future data/AV devices.
E. Size: Selected to fit cored holes in floor and matched to floor thickness.

F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

G. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
   1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

D. Device Installation:
   1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
   4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
   7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
   8. Tighten unused terminal screws on the device.
   9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 “Identification for Electrical Systems.”
B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Tests for Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

D. Test straight-blade [convenience outlets in patient-care areas] [hospital-grade outlets] for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 262726
SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600 V ac and less for use in the following:
      a. Enclosed controllers.
      b. Enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
      a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
      b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
   2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
   5. Coordination charts and tables and related data.
   6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics.
   3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
   4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Bussmann, an Eaton business.
   2. Edison; a brand of Bussmann by Eaton.
   3. Littelfuse, Inc.
   4. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
   1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Motor Branch Circuits: Class RK1, time delay.
   2. Other Branch Circuits: Class RK1, time delay.
   3. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813
SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Fusible switches.
      2. Nonfusible switches.
      3. Enclosures.

1.3 DEFINITIONS
   A. NC: Normally closed.
   B. NO: Normally open.
   C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
      1. Enclosure types and details for types other than NEMA 250, Type 1.
      2. Current and voltage ratings.
      3. Short-circuit current ratings (interrupting and withstand, as appropriate).
      4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
      5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   B. Shop Drawings: For enclosed switches and circuit breakers.
      1. Include plans, elevations, sections, details, and attachments to other work.
      2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For qualified testing agency.
   B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
      1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
         a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.7 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency’s Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

A. Manufacturer’s Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB Inc.
   2. Eaton.
   5. Square D; by Schneider Electric.

B. Type HD, Heavy Duty:
   1. Single throw.
   2. Three pole.
   3. 600-V ac.
   4. 1200 A and smaller.
   5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
   6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton.
2. General Electric Company.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 ENCLOSURES
A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1), gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12), or a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).
C. Conduit Entry: NEMA 250 Types 4 and 4X enclosures shall contain no knockouts.
D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
E. Enclosures designated as NEMA 250 Type 4 or 4X stainless steel shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS
A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION
A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
C. Install fuses in fusible devices.

D. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the two following methods:
         1) Use a low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
      h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
      i. Verify correct phase barrier installation.
      j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
   2. Electrical Tests:
      a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
      b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
      c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
      d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
      e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.
   1. Test procedures used.
   2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
   3. List deficiencies detected, remedial action taken, and observations after remedial action.
3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816
SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Interior solid-state luminaires that use LED technology.
   2. Lighting fixture supports.
   3. Exit signs
   4. Emergency lighting units

B. Related Requirements:
   1. Section 26 09 23 "Lighting Control Devices".
   2. Section 26 09 43 "Distributed Digital Lighting Control System".
   3. Section 26 09 43.23 "Relay-Based Lighting Controls".
   4. Section 26 27 26 "Wiring Devices".
   5. Section 26 51 00 "Interior Lighting".
   6. Section 26 56 00 "Exterior Lighting".
   7. Section 26 56 19 "LED Exterior Lighting".

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture
   1. Arrange in order of fixture designation.
   2. Include data on features, accessories, finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.
   5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
   6. Include data on LED driver including total system wattage, power factor and total harmonic distortion.
   7. Photometric data and adjustment factors based on laboratory tests.
      a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
      b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
   8. Wiring diagrams for power, control, and signal wiring.
10. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

D. Field quality-control test reports.

1.5 INFORMATIONAL SUBMITTALS

A. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of luminaire.

C. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers’ codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: Five for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Drivers: One for every 50 of each type and rating installed. Furnish at least one of each type.
   4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer’s laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
   1. Obtain Architect’s approval of luminaires in mockups before starting installations.
   2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for each lighting fixture is based on the product named in the schedule. Subject to compliance with requirements, provide either the named product or an approved equivalent product specified in the schedule with the specific manufacturer and light fixture series that has been approved. Other manufacturers or other series from a listed manufacturer will not be considered.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. Bulb shape complying with ANSI C79.1.

F. Lamp base complying with ANSI C81.61 or IEC 60061-1.

G. CRI of minimum 80.

H. CCT of 3500 K, unless otherwise indicated.

I. Rated lamp life of minimum 35,000 hours.

J. Nominal Operating Voltage: as indicated on the drawings.

K. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

L. Dimming applications – dimmable from 100 percent to 0 percent of maximum light output.

2.3 MATERIALS

A. LED Driver
   1. Internal to luminaire unless noted otherwise.
   2. Power Factor: 0.90 or higher
   3. Total Harmonic Distortion: less than 20 percent

B. Metal Parts:
   1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:
1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
   a. “USE ONLY” and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 “Hangers and Supports for Electrical Systems” for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Twin-Stem Hangers: Two (2), 0.5-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.


E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.6 EXIT SIGNS

A. Internally Lighted Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.7 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.
1. Lamps: LEDs, 70,000 hours minimum rated lamp life.
2. Battery: Sealed, maintenance-free, lead-acid type rated for automatic 90 minute operation minimum.
3. Charger: Fully automatic, solid-state type with sealed transfer relay.
4. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
6. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:
   1. Ceiling mount with minimum two 5/32-inch-diameter aircraft cable supports with adjustable length.
   2. Ceiling mount with hook mount.

H. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod or wire support for suspension for each unit length of luminaire chassis, including one at each end.
   4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:
   1. Secure to any required outlet box.
   2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 26 05 19 “Low-Voltage Electrical Power Conductors and Cables” for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 “Identification for Electrical Systems.”

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 26 09 43.23 “Relay-Based Lighting Controls.”

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

B. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.

C. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

D. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119
SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Fire-alarm control unit.
   3. System smoke detectors.
   6. Device guards.
   7. Magnetic door holders.
   10. Network communications.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.
B. FACP: Fire Alarm Control Panel.
C. HLI: High Level Interface.
E. PC: Personal computer.
F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
   1. Include construction details, material descriptions, dimensions, profiles, and finishes.
   2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
   1. Comply with recommendations and requirements in the “Documentation” section of the “Fundamentals” chapter in NFPA 72.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
   4. Detail assembly and support requirements.
   5. Include voltage drop calculations for notification-appliance circuits.
   6. Include battery-size calculations.
   7. Include input/output matrix.
   8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
   9. Include performance parameters and installation details for each detector.
   10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
   11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
a. Show critical dimensions that relate to placement and support of detector housing, and remote status and alarm indicators.

b. Show field wiring required for HVAC unit shutdown on alarm.

c. Locate detectors according to manufacturer's written recommendations.

12. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified, fire-alarm technician; Level III minimum.
   c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
   d. Riser diagram.
   e. Device addresses.
   f. Record copy of site-specific software.
   g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      1) Equipment tested.
      2) Frequency of testing of installed components.
      3) Frequency of inspection of installed components.
      4) Requirements and recommendations related to results of maintenance.
      5) Manufacturer's user training manuals.
   h. Manufacturer's required maintenance related to system warranty requirements.
   i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.9 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.
B. Automatic sensitivity control of certain smoke detectors.
C. All components provided shall be listed for use with the selected system.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:
   2. Heat detectors.
   3. Smoke detectors.
   4. Duct smoke detectors.
   5. Automatic sprinkler system water flow.
   6. Fire-extinguishing system operation.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances, including voice evacuation notices.
   2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Unlock electric door locks in designated egress paths.
   5. Release fire and smoke doors held open by magnetic door holders.
   6. Activate voice/alarm communication system.
   7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   8. Activate stairwell and elevator-shaft pressurization systems.
   9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
  10. Recall elevators to primary or alternate recall floors.
  11. Activate elevator power shunt trip.
13. Record events in the system memory.
14. Record events by the system printer.
15. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Alert and Action signals of air-sampling detector system.
4. Elevator shunt-trip supervision.
5. Independent fire-detection and -suppression systems.
6. User disabling of zones or individual devices.
7. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote
   annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
11. Hose cabinet door open.

E. System Supervisory Signal Actions:
1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-
   premises network control panels, and remote annunciators.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving
   station.
5. Transmit system status to building management system.

2.3 FIRE-ALARM SYSTEM

A. Manufacturer: The existing fire alarm control unit shall be expanded and modified as necessary to accommodate
   the new scope of work. New fire alarm system equipment shall be from the same manufacturer as the existing
   system. New detection and notification appliances shall be of the same manufacturer as the existing system.

B. Simplex is not an approved manufacturer.

C. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules,
   complying with UL 864.
   a. System software and programs shall be held in nonvolatile flash, electrically erasable,
      programmable, read-only memory, retaining the information through failure of primary and secondary
      power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
   c. Provide communication between the FACP and remote circuit interface panels, annunciators, and
      displays.
   d. The FACP shall be listed for connection to a central-station signaling system service.
   e. Provide nonvolatile memory for system database, logic, and operating system and event history. The
      system shall require no manual input to initialize in the event of a complete power down condition.
      The FACP shall provide a minimum 500-event history log.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been
   silenced and shall provide selective silencing of alarm notification appliance by building communication
   zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP
   shall be listed for releasing service.
D. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
   1. Annunciator and Display: Liquid-crystal type, three line(s) of 40 characters, minimum.
   2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

E. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
   1. Pathway Class Designations: NFPA 72, Class B.
   2. Pathway Survivability: Level 0.
   3. Install no more than 50 addressable devices on each signaling-line circuit.
   4. Serial Interfaces:
      a. One dedicated RS 485 port for central-station operation using point ID DACT.
      b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
      c. One USB port for PC configuration.
      d. One RS 232 port for voice evacuation interface.

F. Stairwell and Elevator Shaft Pressurization: Provide an output signal using an addressable relay to start the stairwell and elevator shaft pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
   1. Pressurization starts when any alarm is received at fire-alarm control unit.
   2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.

G. Smoke-Alarm Verification:
   1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
   2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
   3. Record events by the system printer.
   4. Sound general alarm if the alarm is verified.
   5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

H. Notification-Appliance Circuit:
   1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
   2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
   3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

I. Elevator Recall:
   1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
      a. Elevator lobby detectors except the lobby detector on the designated floor.
      b. Smoke detector in elevator machine room.
      c. Smoke detectors in elevator hoistway.
   2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
   3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
      a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

J. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

K. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

L. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
   1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.

b. Programmable tone and message sequence selection.

c. Standard digitally recorded messages for "Evacuation" and "All Clear."

d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.

3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

M. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

N. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.


O. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.

2. Detectors shall be four-wire type.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.

b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.

c. Multiple levels of detection sensitivity for each sensor.

d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.

b. Device type.

c. Present average value.

d. Present sensitivity selected.

e. Sensor range (normal, dirty, etc.).
C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
   1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
      a. Primary status.
      b. Device type.
      c. Present average value.
      d. Present sensitivity selected.
      e. Sensor range (normal, dirty, etc.).
   3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
   4. Each sensor shall have multiple levels of detection sensitivity.
   5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.
   1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
   1. Mounting: Adapter plate for outlet box mounting.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
   1. Mounting: Adapter plate for outlet box mounting.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.

C. Voice/Tone Notification Appliances:
   1. Comply with UL 1480.
   2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
   3. High-Range Units: Rated 2 to 15 W.
   4. Low-Range Units: Rated 1 to 2 W.
   5. Mounting: Flush or surface mounted and bidirectional.
   6. Matching Transformers: Tap range matched to acoustical environment of speaker location.
2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
   2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   3. Rating: 24-V ac or dc.

B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. General:
   1. Include address-setting means on the module.
   2. Store an internal identifying code for control panel use to identify the module type.
   3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.
   1. Allow the control panel to switch the relay contacts on command.
   2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:
   1. Operate notification devices.
   2. Operate solenoids for use in sprinkler service.

2.11 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

2.12 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Equipment Mounting: Install fire-alarm control unit on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Equipment Mounting: Install fire-alarm control unit on finished floor.

D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

E. Manual Fire-Alarm Boxes:
1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

F. Smoke- or Heat-Detector Spacing:
1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A [or Annex B] in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

G. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

H. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

I. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

J. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

K. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in non-accessible locations may be routed exposed.
   1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated HVAC duct systems.
   4. Magnetically held-open doors.
   5. Electronically locked doors and access gates.
   6. Alarm-initiating connection to elevator recall system and components.
   7. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   8. Supervisory connections at valve supervisory switches.
   10. Data communication circuits for connection to building management system.
   11. Data communication circuits for connection to mass notification system.
   12. Supervisory connections at fire-extinguisher locations.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Perform the following tests and inspections:
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.11