PROJECT MANUAL
for

EARLY CHILDHOOD ESSER

825 Waycross Road, Cincinnati, OH 45240

for the

Winton Woods City Schools

825 Waycross Road, Suite A, Cincinnati, OH 45240

SHP Comm. No. 2021091.01
March 31, 2022

312 Plum Street, Suite 700
Cincinnati, Ohio 45202
(513) 381-2112

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DOCUMENT 00 11 13 – NOTICE TO BIDDERS

Separate, sealed bids for each of the requirements set forth below will be received at the Winton Woods City Schools Board of Education Office located at **825 Waycross Road, Suite A, Cincinnati, Ohio 45240** until:

2:00 p.m. – local time
June 1, 2022

and will be publicly opened and read immediately thereafter in the Media Center at 825 Waycross Road, Cincinnati, Ohio 45240, and a report thereof made to the board at their next meeting.

Said work consisting of HVAC and building envelope improvements to an existing school facility.

Pre-bid meeting:
Prospective bidders are encouraged to attend a **pre-bid meeting** to be held **May 24, 2022** at **2:00 p.m.** at the following location:

Future Early Childhood Central Campus
825 Waycross Road
Cincinnati, OH 45240

The Contract Documents are available for purchase from: Key Blue Prints Inc., 411 Elliott Ave, Cincinnati, Ohio 45215, (513) 821-2111, www.keycompanies.com. Documents will be forwarded at bidder's expense.

Bids shall be submitted on the form furnished with each set of bid documents or on a photographic copy of that form. Each bid shall be accompanied by a bid guarantee meeting requirements of Section 153.54 of the Ohio Revised Code. Said guarantee may be in the form of a bond (ORC 153.571) or a certified check, cashiers check, or letter of credit meeting requirements of 153.54. Prevailing wage rates apply. Bids received after the time and date set for bid opening will be returned to the bidder unopened.

The said Board of Education reserves the right to waive informalities, and to accept or reject any and all, or parts of any and all bids.

No bids may be withdrawn for at least 60 days after the scheduled closing time for receipt of bids.

The probable construction cost estimate for this work is: $4,850,000 base bid

Board of Education – Winton Woods City School District

By: Steve Denny, Executive Director of Business Affairs

END OF DOCUMENT 00 11 13

AIA® Document A701™ – 2018

Instructions to Bidders

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

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

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

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

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

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

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

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ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the Proposed Contract Documents. The Bidding Requirements consist of the advertisement or invitation to bid, Instructions to Bidders, supplementary instructions to bidders, the bid form, and any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement's Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

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

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

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

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

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from, or that does not change, the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

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

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

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

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 By submitting a Bid, the Bidder represents that:

.1 the Bidder has read and understands the Bidding Documents;

.2 the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid concurrently or presently under construction;

.3 the Bid complies with the Bidding Documents;

.4 the Bidder has visited the site, become familiar with local conditions under which the Work is to be performed, and has correlated the Bidder's observations with the requirements of the Proposed Contract Documents;

.5 the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and

.6 the Bidder has read and understands the provisions for liquidated damages, if any, set forth in the form of Agreement between the Owner and Contractor.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

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

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

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

§ 3.1.3 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the advertisement or invitation to bid, or in supplementary instructions to bidders.

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

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

§ 3.2 Modification or Interpretation of Bidding Documents

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

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

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

§ 3.3 Substitutions

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

§ 3.3.2 Substitution Process

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

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

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

§ 3.3.3 The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

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

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

§ 3.4 Addenda

§ 3.4.1 Addenda will be transmitted to Bidders known by the issuing office to have received complete Bidding Documents.

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

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

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

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

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 Preparation of Bids

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

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

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

§ 4.1.4 Edits to entries made on paper bid forms must be initialed by the signer of the Bid.

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

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall neither make additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached, certifying the agent's authority to bind the Bidder.

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

§ 4.2 Bid Security

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

(Insert the form and amount of bid security.)

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

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

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

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated below:
(Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)

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

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

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

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

§ 4.4 Modification or Withdrawal of Bid

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

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

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

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

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

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

§ 5.3 Acceptance of Bid (Award)
§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. Unless otherwise prohibited by law, the Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's best interests.

§ 5.3.2 Unless otherwise prohibited by law, the Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION
§ 6.1 Contractor's Qualification Statement
Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request and within the timeframe specified by the Architect, a properly executed AIA Document A305™, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted for this Bid.

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

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

.1 a designation of the Work to be performed with the Bidder's own forces;

.2 names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; and

.3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

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

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate Bid to account for the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

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

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND
§ 7.1 Bond Requirements
§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.

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

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

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of the Contract Sum.
(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)

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

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond.

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

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

ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

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

.1 AIA Document A101 2017, Standard Form of Agreement Between Owner and Contractor, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

.2 AIA Document A101 2017, Exhibit A, Insurance and Bonds, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

.3 AIA Document A201 2017, General Conditions of the Contract for Construction, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

.4 AIA Document E203 2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013.)

.5 Drawings

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User Notes: (1750493016)

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda:

Number	Date	Pages

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

[ ] AIA Document E204□ □2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017.)

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents listed below:
(List here any additional documents that are intended to form part of the Proposed Contract Documents.)

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DOCUMENT 00 21 14 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

NOTE:
This section shall serve to supplement, modify, change and/or clarify provisions of the Instructions to Bidders (AIA Document A-701, 2018 Edition, "Instructions to Bidders"). Where an Article of the Instructions to Bidders is not modified or a Paragraph, Subparagraph, or Clause thereof is not modified or deleted by these supplements, the unaltered provisions of that Article, Paragraph, Subparagraph, or Clause shall remain in effect. Where items of this section directly conflict with those of the Instructions to Bidders, the provisions of this section shall prevail.

ARTICLE 2 BIDDER'S REPRESENTATION

Add the following to Article 2:
"2.2 Bidders shall refer to the "Notice to Bidders" for Pre-Bid Meeting requirements."

ARTICLE 3 BIDDING DOCUMENTS

3.1 Distribution

Delete Paragraph 3.1.1 and replace with the following:
"3.1.1 Bidders shall obtain complete Bidding Documents from the issuing office designated in the Notice to Bidders."

Delete Paragraph 3.1.2 in its entirety.

3.2 Modification or Interpretation of Bidding Documents

Add Paragraph 3.2.1.1 as follows:
"3.2.1.1 Each Bidder is responsible for calling to the attention of the Architect any ambiguities, inconsistencies, errors, or omissions which may occur in the documents for their part of the Work. If Bidder fails to request clarification, the Bidder will be expected to overcome such conditions without additions to the bid amount."

Add Paragraph 3.2.2.1 as follows:
"3.2.2.1 Clarification or interpretation can be made via e-mail to amckenzie@shp.com or telephone, 513-381-2112."

3.4 Addenda

Delete Paragraph 3.4.3 and replace with the following:
"3.4.3 If an Addendum is issued within 72 hours prior to the published time for the opening of bids (excluding Saturdays, Sundays, and legal holidays), the time for opening of bids shall be extended one (1) week with no further advertising required."

ARTICLE 4 BIDDING PROCEDURES

4.1 Preparation of Bids

Add Paragraph 4.1.1.1 as follows:
"4.1.1.1 Any change or alteration to the wording of the bid form may cause a Bid to be rejected as non-responsive."

Delete Paragraph 4.1.3 and replace with the following:
"4.1.3 Sums shall be expressed in both words and figures and in figures only where no space is provided for words. In case of discrepancy, the amount written in words shall govern."

Add paragraph 4.1.5.1 and 4.1.5.2 as follows:
"4.1.5.1 A blank entry or an entry of "No Bid", "N/A", or similar entry for any Alternate will cause a Bid to be rejected as non-responsive if that Alternate is selected.

4.1.5.2 If an Alternate is not selected and an entry of "No Bid", "N/A", or similar entry for the Alternate is listed, this action, by itself, will not render the Bid as non-responsive."

Add Paragraph 4.1.9 as follows:
"4.1.9 The Bidder shall include a signed copy of the Bidder's Qualifications and Non-Collusion Affidavit with their Bid; a copy of each form is included in Division 00 of the Project Manual."

4.2 Bid Security

Delete Paragraphs 4.2.1, 4.2.2, 4.2.3 and 4.2.4 and replace with the following:

"4.2.1 Each Bid shall be accompanied by a bid security, in accordance with the Ohio Revised Code (ORC) Section 153.54(B), in the amount of the Base Bid plus ADD Alternates or;

4.2.2 a signed bond in the form of a certified check, cashier's check or letter of credit, as provided in ORC Section 153.54(C). The amount of the certified check, cashier's check or letter of credit shall be equal to ten (10) percent of the Base Bid plus ADD Alternates or;

4.2.3 a bid guaranty and contract bond in accordance with ORC Section 153.571 in the amount of 100 percent of the total Base Bid plus ADD Alternates. If the dollar space on the bid guaranty is left blank, the penal sum will be the full amount of the Base Bid plus ADD Alternates, stated in dollars and cents. A percentage is not acceptable, pursuant to ORC Section 153.571.

4.2.4 The bond shall serve as an assurance that the Bidder will, upon acceptance of the Bid, comply with all conditions precedent for Contract execution, within the time specified.

4.2.5 The bond must be issued by a surety authorized by the Department of Insurance to transact business in Ohio. The bond must be issued by a surety capable of demonstrating a record of competent underwriting, efficient management, adequate reserves, and sound investments. These criteria will be met if the surety currently has an A.M. Best Company Policy Holders Rating of "A+", "A" or "A-" or better and has or exceeds the Best Financial Size Category of Class VII. The bond must be signed by an authorized agent, with Power of Attorney, from a surety.

4.2.6 Bond will be returned to all unsuccessful Bidders after Contract is awarded. If used, a certified check, cashier's check or letter of credit will be returned to the successful Bidder upon providing the bond required by ORC Section 153.54(C).

4.2.7 If for any reason, other than as authorized by Article 4.4, Modifications or Withdrawal of Bid, the Bidder fails to enter into a Contract, and the Owner awards the Contract to the next lowest responsive and responsible Bidder, the Bidder who failed to enter into a Contract shall be liable to the Owner for the difference between the Bidder's Bid and the Bid of the next lowest responsive and responsible Bidder, or for a penal sum not to exceed ten (10) percent of the Bid amount, whichever is less, pursuant to ORC Section 153.54."

4.3 Submission of Bids

Add Paragraph 4.3.1.1 as follows

"4.3.1.1 Submit Bid(s) in paper form, in duplicate, in sealed envelope, at time and place stipulated."

4.4 Modification or Withdrawal of Bid

Delete Paragraph 4.4.3 and replace with the following:

"4.4.3 All Bids are valid for (60) days after the opening of bids. A Bid may be extended thereafter upon mutual agreement, in writing, between the Owner and Contractor. Awards beyond the sixty (60) day period shall be reviewed for increased cost of the Contract only if the cause for delay is no fault of the Contractor and substantiated."

Add Paragraph 4.4.4 as follows:

"4.4.4 A Bidder may withdraw a Bid from consideration after the bid opening if the bid amount was substantially lower than the amounts of other Bids, providing the Bid was submitted in good faith, and the reason for the bid amount being substantially lower was a clerical mistake as opposed to a judgement mistake, and was actually due to an unintentional and substantial arithmetic error or an unintentional omission of a substantial quantity of Work, labor or material made directly in the compilation of the bid amount. Request to withdraw Bid must be made in writing filed with the Owner and Architect within two business days after conclusion of the bid opening."

ARTICLE 5 CONSIDERATION OF BIDS

5.2 Rejection of Bids

Add Paragraphs 5.2.1, 5.2.2 and 5.2.3 as follows

"5.2.1 If the lowest Bidder is not responsive or responsible, the Owner may reject such Bid and shall notify the Bidder the reasons for the finding.

5.2.2 A Bidder notified that they are not responsive or responsible may object to the Owner's decision by filing a written request for reconsideration, which must be received by the Owner within five (5) days of the date of the notice from the Owner.

5.2.3 Upon receipt of a timely request, the Owner shall meet with the Bidder to listen to the Bidder's objections.

.1 No award of contract shall become final until the Owner has met with all Bidders who have filed timely request for reconsideration.

.2 If all request for reconsideration are rejected in the Owner's discretion, the award of contract shall become final, or the Owner, in its discretion, may reject all bids.

.3 If a request for reconsideration is not rejected, any procedures for the determination of the lowest responsible Bidder that have not already been completed concerning the applicable Bidder shall be completed. Following the completed procedures and evaluation of the Bidder, the Bidder will be notified of the findings."

5.3 Acceptance of Bid (Award)

Add Paragraphs 5.3.1.1, 5.3.1.2 and 5.3.1.3 as follows:

"5.3.1.1 Pursuant to ORC Section 153.52, the Contract will be awarded to the lowest responsive and responsible Bidder.

5.3.1.2 In determining the lowest Bidder, the Owner shall consider the Base Bid and any selected Alternates which the Owner determines to accept, and may result in an award to a Bidder other than the Bidder that submitted the lowest Base Bid. Voluntary Alternates will not be considered in determining the lowest amount.

5.3.1.3 The Bidder acknowledges that although there is an estimate for the cost of the Project, the market conditions may and frequently do result in the estimate being different from the sum of the Bids received, either higher or lower. The Bidder understands that the Owner has included alternatives, which include deduct and add Alternates, to give flexibility in building the Project with funds available. The Bidder further understands and acknowledges that the use of add and deduct Alternates is a long held customary practice in the construction industry in the State of Ohio. The Bidder also acknowledges that the Owner will not make a decision about what Alternates on which to base the award of contracts until the Bids are received, and the Owner can compare its available funds with the Base Bids and the cost or savings from selecting different Alternates. No Contract(s) shall be entered into if the total price of all Contracts for the Project that is bid on the same day, are in excess of ten (10) percent above the entire estimate thereof, in accordance with ORC Section 153.12. Project estimate is listed in the Notice to Bidders."

Delete Paragraph 5.3.2 and replace with the following:

"5.3.2 Subject to the right of the Owner to reject each and every Bid, the Owner will determine the lowest responsive Bid by taking into consideration not only the amount of the Bid but such of the following criteria as it, in its discretion, deems appropriate and may give such weight thereto as it deems appropriate in determining the responsibility of the Bidder:

.1 the Bidder's financial ability to complete the Contract;
.2 the Bidder's experience with projects of similar size and scope and more complex projects;
.3 the conduct and performance of the Bidder on previous contracts completed in a timely manner;
.4 the Bidder's facilities and equipment;
.5 the adequacy, in numbers and experience, of the Bidders work force to complete the Contract successfully on time and on budget;
.6 the ability of the Bidder to execute the Contract properly; and
.7 the evaluation of the Bid substantially below the median of other Bids."

Add Paragraphs 5.3.3, 5.3.4 and 5.3.5 as follows:

"5.3.3 The Owner shall obtain from the lowest Bidder any information the Owner deems appropriate to the consideration of factors showing responsibility. The failure to submit requested information on a timely basis may result in the determination that the Bidder is not responsible.

5.3.4 The Bidder authorizes the Owner and its representatives to contact owners, construction managers, contractors, and design professionals on projects on which the Bidder has worked and authorizes and requests such owners, construction managers, contractors, and design professionals to provide a candid evaluation of Bidder's performance. By submitting a Bid, the Bidder agrees that if they or any person at their urging, directly or indirectly, brings action against any of such owners, construction managers, contractors, and design professionals or their employees as a result of or related to such candid elevation and such action is not successful, the Bidder will reimburse such owners, design professionals and/or their employees for all legal fees and expenses incurred by them that are related to such legal action, including the cost of collection. This obligation is expressly intended for the benefit of such owners, construction managers, contractors, design professionals and their employees.

5.3.5 The number of consecutive calendar days required to complete the Work shall be considered by the Owner in determining the lowest and responsive Bidder."

ARTICLE 6 POST-BID INFORMATION

6.2 Owner's Financial Capability

Delete Paragraph 6.2 in its entirety.

6.3 Submittals

Add the following Paragraph after Paragraph 6.3.1.3 as follows:
".4 a list of proposed Contractors and Suppliers."

ARTICLE 7 PERFORMANCE AND PAYMENT BOND

7.1 Bond Requirements

Delete Paragraphs 7.1.1, 7.1.2, 7.1.3, and 7.1.4 and replace with the following:
"7.1.1 The Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.

7.1.1.1 Bonds shall be written in conformance with the Bond Form provided in the Project Manual and in compliance with ORC Section 153.571.

7.1.2 Prior to award of contract, successful Bidders who provided a cashier's check, certified check or letter of credit as bid security shall submit a contract bond in the form of a performance and payment bond in an amount equal to 100% of the contract sum. The performance and payment bond must be signed by an authorized agent of an acceptable surety bonding company and by the Bidder. Bond must be issued by a surety company authorized by Ohio Department of Insurance to transact business in the State of Ohio. The bond shall be issued by a surety company which can adequately demonstrate a record of competent underwriting, efficient management, adequate reserves and soundness of investments. These criteria will be met if the surety currently has an A.M. Best Company Policyholder Rating of "A+", "A", or "A-" or better and has or exceeds the Best Financial Size Category of Class VII.

7.1.3 Bond must be countersigned by an Ohio resident agent if bond is issued by an out-of-state agent.

7.1.4 Performance and payment bond must be supported by credentials showing power of attorney and corporate seals to each copy. Bonds shall remain in effect for 12 months after date of Substantial Completion is issued by the Owner. Certificate by bonding company of compliance is required prior to final acceptance of Project."

7.2 Time of Delivery and Form of Bonds

Delete Paragraph 7.2 in its entirety.

ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

Delete Article 8 in its entirety, and replace with the following:
"**ARTICLE 8 SUPPLEMENTAL BIDDING INFORMATION**

8.1 If the Owner and Bidder enter into a Contract within 60 days of the bid opening, the Contractor shall pay any and all material, labor or subcontract cost increases which have occurred since the bid opening. Contract entered into beyond 60 day period may contain additional amounts for cost increases if the cause for delay is not the fault of the Contractor.

8.2 Prior to the signing of a Contract, the successful Bidder shall furnish:
(i) Certificate of Insurance meeting the requirements of the General Conditions;
(ii) Ohio Workers' Compensation Certificates;
(iii) Ohio Secretary of State Certification;
(iv) Delinquent Personal Property Tax Affidavit as required by ORC Section 5719.042 (form included in Division 00 of the Project Manual);
(v) Campaign Contributions Affidavit as required by ORC Section 3517.13 (form included in Division 00 of the Project Manual);
(vii) Contractor Consent to Escrow Agent/Agreement or waiver of Escrow (form included in Division 00 of the Project Manual); and
(viii) Proof of enrollment in good standing in the Ohio Bureau of Workers' Compensation (BWC) Drug-Free Workplace Program (DFWP) or an equivalent BWC approved DFWP in accordance with ORC Sections 153.03 to 153.031 (form included in Division 00 of the Project Manual).

8.2.1 The award of the Contract and the execution of the Contract are based upon the expectation that the lowest responsible Bidder will comply with the conditions of Section 8.2.

8.2.2 Non-compliance with the conditions within five (5) days of the date that the Bidder is notified of the notice of intent to award the Contract shall be cause for the Owner to cancel the award for the Bidder's

lack of responsibility and award the Contract to another Bidder which the Owner determines is the next lowest responsive and responsible Bidder, or resubmit the Contract for bidding, at the discretion of the Owner.

8.3 Upon the signing of a Contract, the Owner shall notify the Surety and Surety Agent of the award of the contract in compliance with ORC Section 9.32."

ARTICLE 9 PREVAILING WAGES

Add Article 9 to read as follows:

"**ARTICLE 9 PREVAILING WAGE**

9.1 The Owner will pay all or part of the contract sum with federal grant funding. Accordingly, prevailing wages in compliance with the Davis-Bacon Act apply to this project."

END OF DOCUMENT 00 21 14

DOCUMENT 00 41 16 - BID FORM

EARLY CHILDHOOD ESSER

For

Winton Woods City Schools

SUBMITTED BY: _____

(CONTRACTOR FIRM NAME)

SUBMITTED NO LATER THAN

2:00 p.m. - Local Time
June 1, 2022

AT THE OFFICE OF:

Steve Denny, Executive Director of Business Affairs

Winton Woods City School District

Board of Education
825 Waycross Rd, Suite A
Cincinnati, Ohio 45240

DOCUMENTS PREPARED BY:

SHP

312 Plum Street, Suite 700

Cincinnati, Ohio 45202

Bid Form continues on next page

PART A - GENERAL NOTES

The attention of the bidder is called to Notice to Bidders / Instructions to Bidders / Supplementary Instructions to Bidders / Standard Form of Agreement Between Owner and Contractor / General Conditions / Supplementary General Conditions for specific items relating to the execution of the Bid Form. In submitting this bid, the bidder represents that they have carefully reviewed and understands these documents and agrees to the conditions of these documents. Non-compliance with any of the provisions of these documents may constitute sufficient cause for rejection of a bid.

Execute duplicate Bid Form in original for each bid submitted.

Attach Bid Security to first Bid Form.

Attach the following forms to the first Bid Form:

- Bidder's Qualifications
- Non-Collusion Affidavit

Do Not alter the wording of the Bid Form.

Bidders may attach typewritten sheet(s) providing any additional information, voluntary substitutions, or voluntary alternates for the Owner's consideration but the bid amounts contained herein must be based on the bid documents, not such voluntary substitutions or voluntary alternates.

Submit completed Bid Form along with all other required information in a sealed envelope plainly identified as to items being bid and name of bidder. See Instructions to Bidders.

The Owner reserves the right to award separate contracts for each individual item bid or to award combination bids if provided for in this form.

It is understood and agreed that each the Project will achieve **Substantial Completion by November 18, 2022** and **Final Completion by December 18, 2022**, per definition of AIA General Conditions. See Section 00 73 01 "Supplementary General Conditions" Article 8 – Time, including liquidated damages information.

PART B - RECEIPT OF ADDENDA

The following addenda have been received and taken into account in preparation of this bid:

Addenda No.: _____ Addenda No.: _____

Addenda No.: _____ Addenda No.: _____

Bid Form continues on next page

PART C - PROPOSAL

We, the undersigned bidder have fully examined the Contract Documents entitled: **"Early Childhood ESSER"** for **Winton Woods City Schools**, dated **March 31, 2022**, as prepared by SHP, and do hereby propose to perform all Work for the applicable Contract, in accordance with the Contract Documents, for the amounts as follows:

BASE BID

This Base Bid Amount shall include the following Allowances:

Allowance No. 1: Floor Tile Abatement Allowance: $10,000.

ALL LABOR AND MATERIALS, for the sum of: $ _____

Sum in words: _____

ALTERNATES

Alternate No. 1: Integral Blinds in Aluminum Windows

Add to _____ Deduct from _____ Base Bid (check one).

ALL LABOR AND MATERIALS, for the sum of: $ _____

Sum in words: _____

Add to _____ Deduct from _____ Contract Time (calendar days).

UNIT PRICES

Unit-Price No. 1: Asbestos containing floor tile abatement

ALL LABOR AND MATERIALS, for the sum of: $ _____ Per Square Foot

Sum in words: _____ Per Square Foot

Bid Form continues on next page

PART D – BIDDER'S CERTIFICATION

The bidder hereby acknowledges that the following representations in this bid are material and not mere recitals:

1. Bidder has read and understands the Contract Documents and agrees to comply with all requirements of the Contract Documents, regardless of whether the bidder has actual knowledge of the requirements and regardless of any statement or omission made by the bidder which might indicate a contrary intention.
2. Bidder represents that the bid is based upon the Standards specified by the Contract Documents.
3. Bidder has visited the Project site, become familiar with local conditions and has correlated personal observations about the requirements of the Contract Documents. The bidder has no outstanding questions regarding the interpretation of the Contract Documents.
4. Bidder understands domestic steel use requirements as specified in Ohio Revised Code Section 153.011 apply to this project.
5. Bidder understands that the award of separate contracts for the Project will require phased, sequential, coordinated and interrelated operations which may involve interference, disruption, hindrance or delay in the progress of the bidder's Work.
6. Bidder will enter into and execute the agreement with the Owner, if a contract is awarded on the basis of this bid, and if the bidder does not execute an agreement for any reason, other than as authorized by law, the bidder and the bidder's Surety are liable to the Owner as provided in the Ohio Revised Code and as applicable to the Owner.
7. Bidder certifies that the upon the award of a contract, it will make a good faith effort to ensure that all of its employees, while working on the site of the Project, will not purchase, transfer, use or possess illegal drugs or alcohol or abuse prescription drugs in any way.
8. Bidder agrees to furnish any information requested by the Owner to evaluate the responsibility of the bidder.
9. It is understood and agreed that the work embodied in this contract shall be substantially completed per definition of the AIA General Conditions by the milestone dates indicated in the Contract Documents.
10. Costs, per day as shown in the Table of Liquidated Damages (Section 00 73 01 – Supplementary General Conditions) will be accumulated and assessed to all prime contractors (unless specifically released in writing by the Architect or an extension of time is approved by the Architect) after this date until Substantial Completion and Final Completion are achieved, as determined by the Architect.

Bid Form continues on next page

PART E - SIGNATURE PAGE & INFORMATION ABOUT BIDDER

Legal Name of Business _____.

Name of President _____.

Name(s) of Owner (If not Corporation)

_____.

_____.

_____.

Main Office Address _____.

_____.

Company Tax identification Number: _____.

Company Website (if available): _____.

Main Office Telephone Number _____.

Main Office Fax Number _____.

Main Office Contact Person _____.

Main Contact Person E-mail Address _____.

Authorized Signature _____.

Printed name and Title _____.

Date of Signature: _____ .

Attach other documents required

END OF DOCUMENT 00 41 16

DOCUMENT 00 43 13 - BID GUARANTY AND CONTRACT BOND (ORC § 153.571)

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned _____

_____ ("Contractor") as principal and

_____ as sureties are hereby held and

firmly bound unto the **Board of Education of the Winton Woods City School District, Hamilton County, Ohio**, as obligee in the penal sum of the dollar amount of the bid submitted by the principal to the

obligee on _____, 20____, to undertake the project known as:

"**Early Childhood ESSER**" ("Project")

The penal sum referred to herein shall be the dollar amount of the principal's bid to the obligee, incorporating any additive or deductive Alternates made by the principal on the date referred to above to the obligee, which are accepted by the obligee. In no case shall the penal sum exceed the amount of

_____Dollars ($_____).

(If the foregoing blank is not filled in, the penal sum will be the full amount of the principal's bid, including add Alternates. Alternatively, if the blank is filled in the amount stated must not be less than the full amount of the bid including add Alternates, in dollars and cents. A percentage is not acceptable.) For the payment of the penal sum well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

Signed this _____ day of _____, 20____.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH that whereas the above named principal has submitted a bid for work on the Project.

Now, therefore, if the obligee accepts the bid of the principal and the principal fails to enter into a proper contract in accordance with the bid, plans, details, specifications, and bills of material; and in the event the principal pays to the obligee the difference not to exceed ten percent (10%) of the penalty hereof between the amount specified in the bid and such larger amount for which the obligee may in good faith contract with the next lowest bidder to perform the work covered by the bid; or in the event the obligee does not award the contract to the next lowest bidder and resubmits the project for bidding, the principal pays to the obligee the difference not to exceed ten percent (10%) of the penalty hereof between the amount specified in the bid, or the costs, in connection with the resubmission, of printing new contract documents, required advertising, and printing and mailing notices to prospective bidders, whichever is less, then this obligation shall be null and void, otherwise to remain in full force and effect; if the obligee accepts the bid of the principal and the principal within ten (10) days after the awarding of the contract enters into a proper contract in accordance with the bid, plans, details, specifications, and bills of material, which said contract is made a part of this bond the same as though set forth herein.

Now also, if the said principal shall well and faithfully do and perform the things agreed by said principal to be done and performed according to the terms of said contract; and shall pay all lawful claims of subcontractors, materialmen, and laborers, for labor performed and materials furnished in the carrying forward, performing, or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any materialman or laborer having a just claim, as well as for the obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; and surety shall indemnify the obligee against all damage suffered by failure of the principal to perform the contract according to its provisions and in accordance with the plans, details, specifications, and bills of material therefore and to pay all lawful claims of subcontractors, materialmen, and laborers for labor performed or material furnished in carrying forward, performing, or completing the contract and surety further agrees and assents that this undertaking is for the benefit of any subcontractor, materialman, or laborer having a just claim, as well as for the obligee; it being expressly understood and agreed that the liability of the

surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulates and agrees that no modifications, omissions, or additions in or to the terms of the said contract or in or to the plans or specifications therefore shall in any wise affect the obligations of said surety on its bond. The said surety further stipulates that it is authorized to execute bonds in the State of Ohio and that the liability incurred is within the limits of Section 3929.02 of the Ohio Revised Code.

Signed and sealed this _____ day of _____, 20____.

_____
(PRINCIPAL) (Seal)

By: _____

Printed Name & Title: _____

_____
(SURETY) (Seal)

By: _____

Printed Name & Title: _____

_____
NAME OF SURETY'S AGENT

Surety's Agent's Address: _____

_____

Surety's Agent's Telephone Number: _____

Surety's Agent's E-mail: _____

END OF DOCUMENT 00 43 13

DOCUMENT 00 45 13 – BIDDER'S QUALIFICATIONS

Project Number: _____

Project Name: _____

1. **Company Name**: _____

   Physical Address: _____
   Street, Building, Unit

   _____
   City, State, Zip

   Mailing Address (if different): _____
   P.O. Box

   _____
   City, State, Zip

   Telephone Number (w/ Area Code): (_____) _____

   Email address: _____

2. **Overall Experience.** Indicate Bidder's overall experience performing the trades bid, including the years in business performing the trade under present and former business names.

3. **Financial.** The apparent low Bidder shall submit, upon request of the Contracting Authority, either:

   a) An annual financial statement prepared within the 12 months prior to the bid opening by an independent licensed accounting firm; and the name, address, contact person and phone number of the bank normally used by the Bidder for its primary banking; or,

   b) A financial report generated within 30 days prior to the bid opening from Standard and Poor's Financial Services LLC (S&P), Dun & Bradstreet, or a similar company acceptable to the Contracting Authority documenting the financial condition of the Bidder; and the name, address, contact person and phone number of the bank normally used by the Bidder for its primary banking;

   This information is not a public record under Ohio Revised Code Section 149.43; and shall remain confidential, except under proper order of a court.

4. **Facilities & Equipment**. Indicate Bidder's relevant facilities and major equipment (leased or owned).

5. **Ongoing & Relevant Projects.** List all ongoing projects and projects completed in the last 5 years, which are similar in cost and type to the Project. Include scope of Work, Contract value, and project name/contact person/address/phone number for each owner and architect or engineer for each project.

6. **Regulatory / Contractual.** Indicate all occurrences of the following in the last 5 years (indicate if none). For verification, attach documentation, and/or provide sufficient and appropriate detail information such as: project name, owner, contact person and phone number, amount of contract, etc.

   a) State or federal Prevailing Wage violations or judgments

   b) Affirmative Action violations (Attach Certificate of Compliance with Affirmative Action Programs, issued pursuant to Ohio Revised Code Section 9.47)

   c) Contract abandonment, Contract termination, as either a prime- or sub-contractor, or Surety takeover

   d) Debarment by state, federal or local jurisdictions

   e) EPA/OSHA violations

   f) Liquidated damages and Statutory Delay Forfeiture assessed

7. **Management.** Identify individuals assigned to this Project.

   Principal _____Years with firm _____ Total Exp._____

   Project Manager _____Years with firm _____ Total Exp._____

   Field Superintendent _____ Years with firm _____ Total Exp._____

8. Certification. I hereby certify that the information in this entire Bidder's Qualifications form, including all attachments and referenced information, is factual and complete.

Company Name

_____

Authorized Official (please print or type)

_____

Signature of Authorized Official _____
Date_____

END OF DOCUMENT 00 45 13

DOCUMENT 00 45 14 - NON-COLLUSION AFFIDAVIT

State of _____)
) SS:
County of _____)

The Bidder and each person signing on behalf of the Bidder certifies, and in the case of a joint bid, each party thereto certifies as to such party's organization, under penalty of perjury, that to the best of the undersigned's knowledge and belief:

1. The Base Bid, Unit Prices or any Alternate bid in the bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder.
2. Unless otherwise required by law, the Base Bid, Unit Prices or Alternate bid which have been quoted in the bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder prior to the opening, directly or indirectly, to any other Bidder that would have any interest in the Base Bid, Unit Prices or Alternate bid.
3. No attempt has been made or will be made by the Bidder to induce any other individual, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

Authorized Signature: _____

Print Name: _____ Title: _____

Company Name: _____

ADDITIONAL SIGNATURE FOR JOINT VENTURE:

Authorized Signature: _____

Print Name: _____ Title: _____

Company Name: _____

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

_____
Notary Public

My Commission Expires_____

END OF DOCUMENT 00 45 14

DOCUMENT 00 45 15 - DELINQUENT PERSONAL PROPERTY TAX AFFIDAVIT

State of _____)
) SS:
County of _____)

Bid identification –

CONTRACTOR _____

being first duly sworn, deposes and says that he is

_____
(sole owner, a partner, president, secretary, etc.)

of _____ , the party making the forgoing BID; hereby affirms under oath, pursuant to Section 5719.042 of the Ohio Revised Code, that at the time the BID was submitted, my company (was) (was not) charged with delinquent personal property taxes on the General Tax List of Personal Property for _____ County, Ohio, the amount of such due and unpaid delinquent taxes, including due and unpaid penalties and interest shall be set forth below.

A copy of this statement shall be transmitted by the Fiscal Officer to the County Treasurer within 30 days of the date it is submitted.

Delinquent Personal Property Tax	$ _____
Penalties	$ _____
Interest	$ _____

Signed:

_____

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

_____
Notary Public

My Commission Expires_____

END OF DOCUMENT 00 45 15

DOCUMENT 00 45 17 – UNRESOLVED FINDINGS FOR RECOVERY AFFIDAVIT

State of _____)
) SS:
County of _____)

I / WE _____

after being duly sworn, do hereby submit this Adffidavit to the **Board of Education of the Winton Woods City School District, Hamilton County, Ohio.**

Neither the undersigned nor the entity which has submitted the low bid to the **Board of Education of the Winton Woods City School District**

For the following project: **"Early Childhood ESSER"**

Has any unresolved findings for recovery by the Auditor of State, pursuant to Section 9.24 of the Ohio Revised Code, at the time this bid was submitted for the project.

Signed:

_____

_____
(Printed Name and Title)

_____
(Address)

_____
(City) (State) (Zip Code)

END OF DOCUMENT 00 45 17

DOCUMENT 00 45 18 - CAMPAIGN CONTRIBUTIONS AFFIDAVIT

State of _____)
) SS:
County of _____)

Personally appeared before me the undersigned, a bidder in the competitive bidding for

_____ for a _____
(Name of Entity) (Type of Product or Service)

contract let by the **Board of Education of the Winton Woods City School District** who, being duly cautioned and sworn, makes the following statement with respect to prohibited activities constituting a conflict of interest or other violation under Ohio Revised Code Section 3517.13 (campaign contributions and reporting) and further states that the undersigned has the authority to make the following representation on behalf of himself or herself or of the business entity:

1. That no person or persons, whom are owners of at least twenty percent of the above named business or corporation nor any spouse of such person, has made, as an individual, within the two previous calendar years, one or more contributions totaling in excess of one thousand dollars to a candidate for or the holder of a public office having ultimate responsibility for the award of this contract, or to his/her campaign Committee nor have they aggregately given contributions totaling more than one thousand dollars.

2. That no person or persons employed by the above named firm, not their spouses are in violation of any provision of Ohio Revised Code Section 3517.13.

BIDDER:

SIGNATURE: _____

NAME: _____

TITLE: _____

DATE: _____

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

_____
Notary Public

My Commission Expires_____

END OF DOCUMENT 00 45 18

AIA® Document A101® – 2017

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

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

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

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

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

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

The Owner and Contractor agree as follows.

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

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

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

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EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

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

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

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

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

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

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

[ ] By the following date:

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

Portion of Work	Substantial Completion Date

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

ARTICLE 4 CONTRACT SUM

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

§ 4.2 Alternates

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

Item	Price

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

Item	Price	Conditions for Acceptance

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

Item	Price

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

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

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

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ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

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

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

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

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

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

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

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

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

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

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201 2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201 2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

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

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

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

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

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

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

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

§ 5.2 Final Payment

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

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201 2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

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

§ 5.3 Interest

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

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201 2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

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§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201□2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201□2017

[ ] Litigation in a court of competent jurisdiction

[ ] Other *(Specify)*

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

ARTICLE 7 TERMINATION OR SUSPENSION

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

§ 7.1.1 If the Contract is terminated for the Owner□s convenience in accordance with Article 14 of AIA Document A201□2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner□s convenience.)

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

§ 8.2 The Owner□s representative:
(Name, address, email address, and other information)

§ 8.3 The Contractor□s representative:
(Name, address, email address, and other information)

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

§ 8.5 Insurance and Bonds

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

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

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

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

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

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

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

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

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

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

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AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

Winton Woods Early Childhood ESSER
825 Waycross Road
Cincinnati, Ohio 45240

THE OWNER:
(Name, legal status and address)

,
Winton Woods City Schools
825 Waycross Road, Suite A
Cincinnati OH, 45240

THE ARCHITECT:
(Name, legal status and address)

SHP
312 Plum Street, Suite 700
Cincinnati, Ohio 45202

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

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

Init.
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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

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

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

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

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

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

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

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203 2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document

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G202□ □2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party□s sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

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

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

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

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

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

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

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

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

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

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

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

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

ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

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

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

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

§ 3.3 Supervision and Construction Procedures

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

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

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

§ 3.4 Labor and Materials

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

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

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

§ 3.5 Warranty

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

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

§ 3.6 Taxes

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

§ 3.7 Permits, Fees, Notices and Compliance with Laws

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

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

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

§ 3.7.4 Concealed or Unknown Conditions

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

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

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§ 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 Superintendent

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

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

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

§ 3.10 Contractor's Construction and Submittal Schedules

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

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

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

§ 3.11 Documents and Samples at the Site

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

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delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

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

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

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

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

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

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

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

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

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

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

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will

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

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

§ 3.13 Use of Site

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

§ 3.14 Cutting and Patching

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

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

§ 3.15 Cleaning Up

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

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

§ 3.16 Access to Work

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

§ 3.17 Royalties, Patents and Copyrights

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

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§ 3.18 Indemnification

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

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

ARTICLE 4 ARCHITECT

§ 4.1 General

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

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

§ 4.2 Administration of the Contract

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

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

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

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

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

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

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

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

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

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

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

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

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

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

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ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

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

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

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

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

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

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

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

§ 5.3 Subcontractual Relations

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

§ 5.4 Contingent Assignment of Subcontracts

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

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

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

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

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

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

§ 6.2 Mutual Responsibility

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

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

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

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

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

§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

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

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

§ 7.3 Construction Change Directives

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

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

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

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

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

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.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers compensation insurance, and other employee costs approved by the Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

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

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

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

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

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

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

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect s order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect s order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.2 Progress and Completion

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

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

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

§ 8.3 Delays and Extensions of Time

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

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

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

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

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

§ 9.2 Schedule of Values

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

§ 9.3 Applications for Payment

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

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

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

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

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

§ 9.4 Certificates for Payment

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

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

§ 9.5 Decisions to Withhold Certification

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

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;

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.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a Separate Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

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

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

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

§ 9.6 Progress Payments

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

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

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

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

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

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

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

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

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§ 9.7 Failure of Payment

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

§ 9.8 Substantial Completion

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

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

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

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

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

§ 9.9 Partial Occupancy or Use

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

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

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

§ 9.10 Final Completion and Final Payment

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

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

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

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

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

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

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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

§ 10.2 Safety of Persons and Property

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

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.1 employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

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

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

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

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

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

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

§ 10.2.8 Injury or Damage to Person or Property

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

§ 10.3 Hazardous Materials and Substances

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

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will

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promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

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

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

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

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

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

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

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

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

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act

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or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

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

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

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

§ 11.3 Waivers of Subrogation

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

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

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

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

§11.5 Adjustment and Settlement of Insured Loss

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

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

§ 12.2.2 After Substantial Completion

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

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

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

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

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

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

§ 12.3 Acceptance of Nonconforming Work

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

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

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

§ 13.2 Successors and Assigns

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

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and

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approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

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

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

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

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

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

§ 13.5 Interest

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

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

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

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

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

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

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

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

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

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

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

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

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

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

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

§ 14.4 Termination by the Owner for Convenience

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

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

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

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

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

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

§ 15.1.2 Time Limits on Claims

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

§ 15.1.3 Notice of Claims

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

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

§ 15.1.4 Continuing Contract Performance

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

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

§ 15.1.5 Claims for Additional Cost

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

§ 15.1.6 Claims for Additional Time

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

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

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§ 15.1.7 Waiver of Claims for Consequential Damages

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

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

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

§ 15.2 Initial Decision

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

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

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

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

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

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

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

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

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

§ 15.3 Mediation

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

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

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

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

§ 15.4 Arbitration

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

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

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

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

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§ 15.4.4 Consolidation or Joinder

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

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

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

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SECTION 00 73 01 - SUPPLEMENTARY GENERAL CONDITIONS

NOTE:
This section shall serve to supplement, modify, change and/or clarify provisions of the General Conditions (AIA Document A201, 2017 Edition, "General Conditions of the Contract for Construction"). Where an Article of the General Conditions is not modified or a Paragraph, Subparagraph, or Clause thereof is not modified or deleted by these supplements, the unaltered provisions of that Article, Paragraph, Subparagraph, or Clause shall remain in effect. Where items of this section directly conflict with those of the General Conditions, the provisions of this section shall prevail.

ARTICLE 1: GENERAL PROVISIONS

1.1.3 THE WORK

1.1.3 (Add the following text to the end of the paragraph) "The Contractor shall familiarize himself with the Contract Documents and complete the work intended to be described to the entire satisfaction of the Owner and Architect and shall not avail himself of any manifest error or omission should such exist. The Contractor acknowledges and agrees that the Contract Documents are sufficient to provide for the completion of the work and include work, whether or not shown or described, which reasonably may be inferred to be required or useful for the completion of the work in accordance with applicable laws, codes and customary standards of the construction industry."

1.1.8 INITIAL DECISION MAKER – delete this entire paragraph.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

1.2.4 (Add) "If the Drawings or Specifications conflict, the Contractor is required to provide the greater quantity or higher quality of work called for. When a duplication of material, equipment or task occurs in the Drawings or Specifications by assignment of work to separate Prime Contracts, each Prime Contractor shall be deemed to have bid on the basis of each providing such material, equipment or task. The Architect will decide which Prime Contractor shall provide the same and which Prime Contract amount shall be adjusted, for not incorporating such into the Project. However it is highly recommended that these discrepancies be brought to the Architect's attention prior to bidding."

1.2.5 (Add) "It is the intent of the Contract Documents to accomplish a complete and first-grade installation in which there shall be installed new products of the latest and best design and manufacturer, and workmanship shall be thoroughly first class, executed by competent and experienced workmen.

.1 Details of preparations, construction, installation, and finishing encompassed by the Contract Documents shall conform to the best practices of the respective trades, and that workmanship, construction methods, shall be of quality so as to accomplish a neat and quality finished job.

.2 Where specific recognized standards are mentioned in the Specifications, it shall be interpreted that such requirements shall be complied with.

.3 The intent of the Contract Documents is to include all labor, equipment, and materials necessary for the proper and timely execution and completion of the Work, even though such labor, equipment, and materials are not expressly included in the Contract Documents.

.4 The Contractor will be required to perform all parts of the Work, regardless of whether the parts of the Work are described in Sections of the Contract Documents applicable to other trades."

1.7 DIGITAL DATA USE AND TRANSMISSION
Delete the original text in this section and replace with the following:

1.7.1 (Add) "The Architect, at his sole discretion and without obligation, may make the Contract Documents available for use by Contractors for the purpose of facilitating the coordination process in electronic format. These electronic documents remain the Architect's Instruments of Service and shall be for use solely with respect to this Project, as provided in the Standard Form of Agreement Between Owner and Architect and Article 1.5 herein. The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203-2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development , use, transmission, and exchange of digital data."

1.7.2 (Add) "Where the parties come to agreement per paragraph 1.7.1, the electronic documents shall be made available in RVT or DWG format, as determined by the Architect. They are available through the

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Architect's office upon request. A sample of the format will be provided by the Architect upon request by the Contractor, for the purpose of testing the compatibility of the format to Contractor's systems."

1.7.3 (Add) "The Architect reserves the right to strip the files of the Project's name and address, the Architect's and his consultant's name and address, and any professional licenses indicated on the Contract Documents, and all dimensions, verbiage, and statistical information. Use of these electronic documents is solely at the Contractor's risk, and shall in no way alter the Contractor's Contract for Construction."

1.7.4 (Add) "The Architect shall not be responsible or liable for errors, defects, inexactitudes, or anomalies in the data, information, or documents (including drawings and specifications) caused by the Architect's or its consultant's computer software or hardware defects or errors; the Architect's or its consultant's electronic or disk transmittal of data, information or documents; or the Architect's or its consultant's reformatting or automated conversion of data, information or documents electronically or disk transmitted from the Architect's consultants to the Architect. The Contractor waives all claims against the Architect, its employees, officers and consultants for any and all damages, losses, or expenses the Contractor incurs from such defects or errors in the electronic documents. Furthermore, the Contractor shall indemnify, defend, and hold harmless the Architect, and its consultants together with their respective employees and officers, harmless from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorney's fees and litigation expenses) attributed to errors or defects in data, information or documents, including drawings and specifications, resulting from the Contractor's distribution of electronic documents to other contractors, persons, or entities."

ARTICLE 2: OWNER

2.3 Information and Services Required of the Owner

2.3.1 (Delete the text in this paragraph and replace with the following) "Except for permits, fees, design review fees, inspections, meter costs, licensing, taxes, and other service fees that are assigned to the Contractor as enumerated in paragraph 3.7.1, the Owner shall secure and pay any additional easements, assessments and charges not specifically assigned to the Contractor.

2.3.6 (Add the following text to the end of the paragraph) "The cost of Contractor's reproductions shall be borne by the Contractor at no additional cost to the Owner."

2.4 OWNER'S RIGHT TO STOP THE WORK
Delete the word "repeatedly" from paragraph 2.3. (Add the following text to the end of the paragraph) "This right shall be in addition to, and not in limitation of, the Owner's rights under Paragraph 12.2."

2.5 OWNER'S RIGHT TO CARRY OUT THE WORK
(Delete the text in this paragraph and replace with the following) "If the Contractor defaults or neglects to carry out the Work, in any respect, in accordance with the Contract Documents by either (1) failing to commence to correct such default or neglect within 48 hours after written notice thereof from the Architect or the Owner, (except such period shall be 7 days if the notice is given after final payment), or (2) fails to use its best efforts to continue to correct such default or neglect to the satisfaction of the Owner and Architect, or (3) fails to fully correct such default or neglect within 30 days of such notice to the satisfaction of the Architect and the Owner, then the Owner may, upon written notice of the Contractor and without prejudice to the other remedies the Owner may have, carry out the Work referenced in the written notice to the Contractor; provided that if such default or neglect results in a threat to the safety of persons or property, the Contractor shall immediately commence to correct such default or neglect upon receipt of written or oral notice thereof. If the notice is given before final payment, an appropriate Change Order shall be issued deducting from the payments then or thereafter due the Contractor the costs of correcting such deficiencies, including compensation for the Architect's additional services made necessary by such default, neglect, or failure and the Owner's administrative and legal expense, including the time of the Owner's personnel in dealing with such default. If payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner. The time of the Owner's personnel in dealing with such default will be calculated at the rate of $65.00 per hour."

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

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3.2.5 (Add) “Before ordering material or performing any Work, the Contractor shall verify all measurements at the Project site. Any difference between dimensions on the Drawings and actual measurements shall be brought to the Architect's attention for consideration before the Work proceeds. Where actual measurements require more material and work than the Drawings call for, such material and Work shall be supplied at the cost of the Contractor. No extra compensation will be allowed because of difference between actual measurements and dimensions indicated on the Drawings. The Contractor shall assume full responsibility for accuracy of measurements obtained at the work site.”

3.2.6 (Add) “Mechanical and Electrical Drawings are diagrammatic only. Actual work involved shall be installed from approved Shop Drawings with all measurements obtained at the Project Site by the Contractor.”

3.2.7 (Add) “Dimensions which are lacking from the Drawings shall be obtained from the Architect. In no case will the Contractor assume that the Drawings are scaled.”

3.2.8 (Add) “All Contractor inquiries of Owner/Architect shall be in writing and in the form of an RFI (Request for Information). RFI forms can be that of Prime Contractors standard or of a form prepared by the Architect. RFI’s are to come direct from the Prime Contractor (not Subcontractor or supplier) and all RFI’s are to be numbered and tracked by the Prime Contractor.”

3.5 WARRANTY

3.5.1 (Delete the text in this paragraph and replace with the following) “In addition to any other warranties, guarantees, or obligations set forth in the Contract Documents or applicable as a matter of law and not in limitation of the terms of the Contract Documents, the Contractor warrants and guarantees that:

.1 The Owner will have good title to the Work and materials and equipment incorporated into the Work will be new.

.2 The Work and materials and equipment incorporated into the Work will be free from defects, including defects in the workmanship or materials.

.3 The Work and equipment incorporated into the Work will be fit for the purpose for which they are intended.

.4 The Work and materials and equipment incorporated into the Work will be merchantable.

.5 The Work and materials and equipment incorporated into the Work will conform in all respects to the Contract Documents.

.6 All work performed under the terms of this contract will be guaranteed for a minimum period of one (1) year from the date of Substantial Completion.

.7 Partial occupancy of the premises use of the equipment shall not constitute the beginning of the guarantee period(s), unless agreed to by the Owner in writing.”

3.5.3 (Add) “Upon notice of the breach of the foregoing warranties or guarantees or other warranties or guarantees under the Contract Documents, the Contractor, in addition to other requirements in the Contract Documents, will commence to correct such breach and damage resulting therefrom within 48 hours after written notice thereof, thereafter will use its best efforts to correct such breach and damage to the satisfaction of the Owner and, except where an extension of time is granted in writing by the Owner, correct such breach and damage to the satisfaction of the Owner within 30 days of such notice; provided that if such notice is given after final payment hereunder, such 48 hour period shall be extended to 7 days. If the Contractor fails to commence to correct such breach and damage, or correct such breach and damage as provided above, the Owner, upon written notice to the Contractor and without prejudice to its other written notice to the Contractor and without prejudice to his other rights or remedies, may correct the deficiencies. The Contractor upon written notice from the Owner shall pay the Owner, within 10 days after the date of such notice, the Owner’s costs and expenses incurred in connection with such correction, including without limitation the Owner's administrative and legal expenses. The foregoing warranties and obligations of the Contractor shall survive the final payment and termination of the Contract.”

3.6 TAXES

3.6 (Delete the text in this paragraph and replace with the following) “Materials purchased for use or consumption with the proposed work will be exempt from the State of Ohio Sales Tax as provided for in Section 5739.02 of the Revised code of Ohio and also from the State of Ohio Use Tax, Section 5741.01. Purchases by the Contractor of expendable items such as form lumber, tools, oils, grease,

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fuel, or equipment rentals, are subject to the application of Ohio Sales or Use Tax."

3.7 PERMITS, FEES AND NOTICES AND COMPLIANCE WITH LAW

3.7.1 (Delete the text in this paragraph and replace with the following:) "The process of reviewing and the subsequent awarding of a Building Permit can take an extended period of time, depending on a Building Department's current workload. Realizing that a delay in this process may delay the final completion date of the Work if it is not applied for until after the Contractor is awarded the Contract, SHP shall expedite the Building Permit process by submitting a general Building Permit Application with the required number of Contract Documents to the appropriate Building Department. The submittal for general Building Permit in no way alters the Contract between the Owner and the Contractor, nor does it relieve the Contractor of his or her responsibilities concerning the terms of AIA General Conditions. The Owner shall pay for the General Building Permit. The Contractor shall secure and pay for all other permits, design review fees, inspections, meter costs, licensing, taxes, and other service fees required by authorities having jurisdiction over work related to each specific contract shall be included in that specific contract (unless specifically noted otherwise in Contract Documents). Contractor is responsible for scheduling all inspections and must notify Architect in writing of any design modifications required by local jurisdiction. Contractor shall be responsible for all additional costs resulting out of improper notifications as it relates to Owner, Architect, or other Prime Contractors."

3.7.4 Concealed or Unknown Conditions. Replace "14 days" with "7 days".

3.9 SUPERINTENDENT

3.9.4 (Add) "The Contractor's Superintendent shall be satisfactory to the Architect and the Owner, and the Architect and Owner shall have the right to require the Contractor to remove a Superintendent from the Project whose performance is not satisfactory, and to replace the Superintendent with a Superintendent who is satisfactory to the Architect and Owner. The Contractor shall be required to have a full time Superintendent on the Project every day during the course of the Project."

3.10 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULES

3.10.4 (Add) "The job progress schedule shall be in form as prescribed or approved by the Architect."

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.5 (Add the following to the end of this paragraph) "Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect without action."

3.18 INDEMNIFICATION

3.18.1 (Delete the text in this paragraph and replace with the following) "To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of them from and against claims, damages, losses and expenses, including but not limited to attorneys' and consultants' fees and the cost of their staff, arising out of or related to the performance of the Work, including but not limited to claims for bodily injury, sickness, disease or death, or to injury to or destruction of or loss of use of real or personal property, claims due to delays in or acceleration of the work of other Contractors, claims for loss of productivity, claims for additional storage and handling charges, claims for escalation of the cost of labor and materials, claims for home office overhead, liens against funds, and claims related to the removal, handling or use of hazardous materials. The Owner may set off an amount equal to the sums for which it is entitled to be indemnified from the amounts otherwise due the Contractor under the Contract Documents. The time of the Owner's personnel in dealing with such default will be calculated at the rate of $65.00 per hour."

3.18.3 (Add) "The Contractor will be held responsible for all damage to the Work under construction during the performance and until Substantial Completion and acceptance, even though partial payments have been made under the Contract. He will be held answerable for all damages that may occur to persons, to property, animals or vehicles from want of proper shoring, bracing, lighting, watching, boarding, or enclosing; and for any accident arising from defective apparatus or any negligence on the part of himself or his employees. The Contractor covenants and agrees to pay all damages for injury to real or

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personal property or for any injury or death sustained by any person growing out of any act or deed of the Contractor or of his employees or any of his Subcontractors or their employees."

3.19 (Add) "UNDERGROUND UTILITY FACILITIES"

3.19.1 (Add) "The Contractor, at least two (2) working days prior to commencing construction in an area which may involve underground utility facilities, shall give notice to the Owner, to the registered underground utility protection services, and the Owners of underground utility facilities shown on the Plans and Specifications. The Contractor shall alert immediately the Owner, the occupants of any premises near the Work, and the Architect as to any emergency that it may create or discover. The Contractor shall notify the Owner, the operator of the underground facility, and the Architect of any break or leak in the utility lines or any dent, gouge, groove, or other damage to such lines or to their rating or cathodic protection, made or discovered in the course of excavation."

3.20 (Add) "LIEN WAIVERS AND NOTICES OF COMMENCEMENT"

3.20.1 (Add) "The Contractor will obtain from all its Subcontractors and suppliers, regardless of tier, a lien waiver, at the time they submit for final payment for all labor, materials, equipment, and/or supplies provided for the Project, of all lien rights they have with respect to the Project in the form of the Lien Waiver included in the Contract Documents or in such other form requested by the Architect and immediately deliver a copy of the executed lien waivers to the Architect with Final Request for Payment. The Contractor will provide all Subcontractors and suppliers a copy of its Bid Guaranty and Performance Bond/Contract Bond. By entering into an agreement to provide labor, materials, equipment and/or supplies for the Project, such Subcontractors and suppliers agree to provide such lien waiver to the Contractor. Upon receipt of Notices of Furnishing, the Contractor will deliver copies of the Notices of Furnishing to the Owner."

ARTICLE 4: ARCHITECT

4.2.1 (Add the following text to the end of the first sentence) "…and with the Owner's concurrence, from time to time during the one-year period for correction of work described in Article 12."

4.2.4 Delete the last sentence of this paragraph.

4.2.10 Add the following at the end of the last sentence: "as set forth in the Owner-Architect Agreement."

ARTICLE 5: SUBCONTRACTORS

5.3.1 (Add) "All subcontracts are to be in writing, and the Contractor shall be responsible to forward copies to the Owner upon request."

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

6.2 MUTUAL RESPONSIBILITY

6.2.3 (Delete the second sentence and replace with the following) "Claims and other disputes and matters in question between the Contractor and other Contractors shall be subject to the provisions of Article 15. If such other Contractors initiate legal or other proceedings against the Owner on account of damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor who shall defend such proceedings at its own expense, and if judgment or award against the Owner arises therefrom, the Contractor shall pay or satisfy it and shall reimburse the Owner for attorneys' fees and court or other costs which the Owner has incurred over and above those paid for directly by the Contractor. The Contractor, by execution of this contract, agrees and fully understands the risks and responsibilities associated with this mutual responsibility and has bid accordingly. All costs incurred by the Owner and/or Architect resulting from Contractors filing claims against the Owner for damages caused by another Contractor, shall be borne by that Contractor filing claim."

6.2.4 Delete the word . . . "wrongfully" . . . in this paragraph.

ARTICLE 7: CHANGES IN THE WORK

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7.2.2 (Add) "Change orders shall be executed on AIA Document G701-2001. Methods used in determining adjustments to the Contract Sum shall be those listed in paragraph 7.3.3."

7.3 CONSTRUCTION CHANGE DIRECTIVES

7.3.4 (Change the phrase in the first sentence) . . . "or if no such amount is set forth in the agreement, a reasonable amount." . . . to read . . . "in accordance with the schedule set forth in this paragraph 7.3.12 below."

7.3.8 (Revise the last sentence of paragraph 7.3.8 to read as follows) . . . 'When both additions and deletions are involved in any one change, the allowance for overhead and profit shall be figured on the basis of net increase or decrease, if any with respect to that change."

7.3.10 (Add the following at the end of this paragraph) “When either the Owner or the Contractor disagree with the determination made by the Architect concerning adjustments in the Contract Sum and Contract Time, such disagreement shall be resolved in the manner set forth in Article 15."

7.3.11 (Add) "In paragraphs 7.3.3 and 7.3.4, the allowance for overhead and profit combined, included in the total cost to the Owner, shall be based on the following formula for changes.

.1 Cost to which overhead and profit is to be applied shall be determined in accordance with paragraph 7.3.4.

.2 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs 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. The Architect will prepare all Change Orders for the Owner's authorization."

7.3.12 (Add) "The cost or credit to the Owner as provided in Clause 7.3.3.3 and Clause 7.3.3.5 shall be determined in the following manner:

.1 Labor - all field and shop labor at the base rate without fringe benefits. (The payroll to be based on straight time only.)
a). Foreman shall be included at actual time involved and at normal foreman rates.
b). Supervisor's time shall not be included, but shall be part of the Overhead (subparagraph .5).

.2 All established payroll taxes, assessments and fringe benefits. This may include FICA, Federal unemployment, local health and welfare, local pension fund, State unemployment, workers' compensation, public liability and property, and local apprentice fund.

.3 Materials:
a). Agreed-on value of materials taken from the Contract Work, either as used or unused materials.
b). The net cost of all materials purchased for this work.

.4 Actual rental charges for rented equipment.

.5 10% (percent) Overhead on items .1, .2, .3, and 4.

.6 5% (percent) profit on Items .1, .2, .3, .4, and .5.

.7 Work computed by Subcontractors shall be computed in the same manner as above.

.8 A maximum of 5 percent of Subcontractor's Work (applicable only where the Work performed by Subcontractors is supervised by the Contractor for all other costs and expenses including administrative overhead, profit, and supervision).

.9 Other reimbursable items (without overhead or profit).
a). Extra "out-of-pocket" insurance premiums.
b). Fees for extra permits, licenses, inspections, etc.
c). Premium payments for overtime work or special conditions with prior written consent of the Owner.

.10 The use of the Contractors and Subcontractor's small tools, lightweight equipment, gear, simple scaffolds, etc., shall be considered a part of the overhead cost."

7.3.13 (Add) "Contractors overhead and profit for Change Orders, on Work by his own forces, shall be limited to 10 percent overhead and 5 percent profit. Contractors’ overhead and profit for Change Orders for Work by Subcontractor shall be limited to 5 percent total overhead and profit. Any Subcontractor's overhead and profit for Change Orders shall be limited to 10 percent overhead and 5 percent profit."

7.3.14 (Add) “Where the Contractor bids with respect to an alternate which is not accepted at the time of the entry into the Owner-Contractor Agreement and the Owner subsequently desires to proceed with the

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Work described in the alternate, the amount of the Change Order for such alternate will not exceed the Contractor's bid on such alternate, except where the Architect determines an equitable adjustment is required."

7.3.15 (Add) "In order to facilitate checking of quotations for extras or credits, proposals, except those so minor that their propriety can be seen by inspection, 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 involving over $500 be approved without such itemization. The Contractor shall submit same to the Architect within 14 days after receipt of proposal request."

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

8.2.4 (Add) "If the Architect determines that the Contractor is not cooperating or coordinating its work properly with other Contractors, not supplying sufficient skilled workers, not cleaning up the Project, not furnishing the necessary materials, equipment, or any temporary services or facilities to perform the Work in strict conformance with the Contract Documents or the Contractor is not on schedule, or is not otherwise performing its obligations under the Contract Documents, THE CONTRACTOR WILL IMMEDIATELY, AND IN NOT LESS THAN FORTY-EIGHT HOURS AFTER NOTICE OF SUCH DETERMINATION, OR SUCH OTHER TIME AS MAY BE PROVIDED IN THE CONTRACT DOCUMENTS, (1) COMMENCE SUCH ACTION AS IS NECESSARY TO CORRECT THE DEFICIENCIES NOTED BY THE ARCHITECT, (2) PROCEED TO USE ITS BEST EFFORTS TO CORRECT SUCH DEFICIENCIES TO THE SATISFACTION OF THE ARCHITECT AND THE OWNER, AND (3) IF THE ARCHITECT INSTRUCTS THE CONTRACTOR TO TAKE SPECIFIED CORRECTIVE ACTION, THE CONTRACTOR IMMEDIATELY WILL TAKE SUCH CORRECTIVE ACTION, including, but not limited to, increasing the number of skilled workers, providing temporary services or facilities, and cleaning up the Project. Such action will be taken and continued uninterrupted without waiting to initiate any dispute under the General and Supplementary General Conditions of the Contract for the Project or the resolution of any dispute initiated thereunder."

8.2.5 (Add) "The Contractor, i) will cooperate with the Architect by providing timely information for the scheduling of the times and sequence of the operations required for the Work to be substantially complete as required by the Contract Documents, ii) will continuously monitor the current progress schedule so as to be fully familiar with the timing, phasing, and sequence of the operations of the Work and to the other Work on the Project, and iii) will execute the Work in accordance with the requirements of the current progress schedule."

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.1 (Delete the text in this paragraph and replace with the following) "If the Contractor is delayed at any time in its progress of the Work by one of the delays for which an extension of time is permitted and gives the Architect written notice specifically describing the delay within 48 hours of its commencement, the date for the Substantial Completion of the Work will be extended by Change Order for such reasonable time as the Architect may determine. The failure to give such notice will constitute an irrevocable waiver of the Contractor's right to seek an extension for such delay. The only delays for which the Contractor will be entitled to an extension of the time for completion will be delays caused by the, i) Architect or the Owner, ii) physical damage to the Project over which the Contractor has no control, iii) labor disputes beyond the control of the Contractor, and iv) unusually severe weather conditions not reasonably anticipatable (temperature, rain, or other precipitation within a range of twenty percent of normal amounts for the time of the year covered by the Agreement shall not be considered unusually severe weather conditions). Extensions of time will only be granted pursuant to the procedures for Change Orders set forth in the General Conditions. The Contractor agrees not to make claims for compensation for delays or acceleration in the performance of the Work resulting from acts or failure to act by the Owner, the Architect, or the employees, agents, or representatives of the Owner, or the Architect and agrees that such claim shall be fully compensated by an extension of time to complete the Work, regardless of when granted."

8.3.3 (Delete the text in this paragraph and replace with the following) "The Contractor's sole remedy in the event of a delay shall be an extension of time, and in such event, the Contractor shall not be entitled to any damages."

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8.4 (Add) "COMPLETION OF WORK AND LIQUIDATED DAMAGES"

8.4.1 (Add) "Damages for Delays for Substantial Completion and for Project Closeout shall be in accordance with Article 8 and the following provisions: (The length of time for each is noted in the Bid Form)."

8.4.2 (Add) "Substantial Completion: If the Contractor shall neglect, fail, or refuse to achieve Substantial Completion as herein specified, or fail to secure an extension of time for delays from the Owner, then the Contractor does hereby agree, as a part consideration for the awarding of the Contract, to pay the Owner the amount specified in the Table of Liquidated Damages, not as a penalty, but as liquidated damages for such breach of Contract as hereinafter shall be in default after the time stipulated in the Bid Form for completing the work."

8.4.3 (Add) "Project Closeout: Inasmuch as failure to complete project closeout within the time fixed in the Certificate of Substantial Completion (45 calendar days maximum) will result in substantial injury to the Owner, and as damages arising from such failure cannot be calculated with any degree of certainty, it is hereby agreed that if the Project is not fully and finally completed according to the requirements issued in the Certificate of Substantial Completion including all listed work (punch list) attached to the Certificate and including all project closeout documents listed in the Project Manual, the Contractor shall pay to the Owner the amount specified in the Table of Liquidated Damages, not as a penalty, but as liquidated damages for such breach of Contract as hereinafter shall be in default after the time stipulated in the Contract and Bid Form for completing project closeout."

8.4.4 (Add) "These project closeout liquidated damages shall be paid in addition to any other liquidated damages, penalties, excess expenses or costs payable by the Contractor to the Owner under the provisions of the General Conditions, and shall not exclude the recovery of damages by the Owner under other provisions of the Contract Documents except for Contractors delay. This provision of liquidated damages for project closeout delay shall in no manner affect the Owner's right to terminate the Contract as provided in the General Conditions or elsewhere in the Contract Documents. The Owner's exercise of the right to terminate shall not release the Contractor from his obligation to pay said liquidated damages in the amounts set forth in the Table of Liquidated Damages up to the point of termination."

8.4.5 (Add) "It is further agreed that the Owner may deduct from the balance retained by the Owner, under the provisions above, all liquidated damages stipulated herein for delay or termination, as the case may be, or such portions thereof as the said retained balance will cover."

8.4.6 (Add) "The said amount is fixed and agreed upon by and between the Contractor and the Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be deducted from any payment due or to become due to the Contractor."

8.4.7 (Add) "Table of Liquidated Damages is as follows:

Table of Liquidated Damages

Total Contract Amount at time of Substantial Completion	Dollars per Day Substantial Completion Delay	Dollars per day Project Closeout Delay
$ 1.00 to $ 50,000.00	$ 200.00	$ 1,000.00
$ 50,000.01 to $ 150,000.00	$ 350.00	$ 1,000.00
$ 150,000.01 to $ 500,000.00	$ 500.00	$ 1,000.00
$ 500,000.01 to $ 2,000,000.00	$ 1,000.00	$ 1,000.00
$ 2,000,000.01 to $ 5,000,000.00	$ 2,000.00	$ 1,000.00
$ 5,000,000.01 to $ 10,000,000.00	$ 2,500.00	$ 1,000.00
$ 10,000,000.01 or more	$ 5,000.00	$ 1,000.00

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ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES
(Add the following to the end of this paragraph) "Progress payments and retainage provisions shall be in accordance with the provisions of the Ohio Revised Code pertaining to this matter. The form of the Contractors' Applications for Payment shall be as approved by the Owner."

9.3 APPLICATIONS FOR PAYMENT

9.3.1 (Delete the text in this paragraph and replace with the following) "Applications for payment shall be made at approximately 30 day intervals in accordance with the dates established in the Standard Form of Agreement Between Owner and Contractor. At least 15 days before each progress payment falls due, the Contractor shall submit to the Architect, in triplicate, an itemized Application for Payment, notarized, and supported by such data substantiating the Contractor's right to payment as the Owner or the Architect may require. The form of Application for Payment shall be AIA Document G702 (1992) - Application and Certification for Payment, supported by AIA Document G703 (1992) - Continuation Sheet. No other forms of Application for Payment will be acceptable. Continuation Sheet (G703) shall be prepared the same as in the Schedule of Values submitted by the Contractor. Provided the Contractor's payment application has been submitted on a timely basis and is complete, the Owner will pay the Contractor within thirty (30) days after the Contractor's payment application is approved by the Architect. The Contractor will only be entitled to payment to the extent such approval is given. Payment and retainage shall be as described in the Owner-Contractor Agreement. Such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives but not yet included in Change Orders."

9.3.1.1 (Delete the text in this paragraph, and replace with the following) "Upon request, the Contractor shall submit with each monthly Application for Payment, 1) an Affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the previous Application, was submitted and the Owner or his property might in any way be responsible, have been paid or otherwise satisfied, and 2) release or waivers of liens arising out of the Contract from each Subcontractor, materialmen, supplier, and laborer of the Contractor in the form of Partial Lien Waiver or such other form as the Architect may require."

9.3.1.2 (Delete the text in this paragraph, and replace with the following) "Upon request, the Contractor immediately will supply the Architect with such information as may be requested so as to verify the amounts due the Contractor including, but not limited to, original invoices for materials and equipment and documents showing that the Contractor has paid for such materials and equipment, and so as to verify that amounts due laborers, Subcontractors, and materialmen have been paid to them."

9.3.2 (Add the following to the end of this paragraph) "Payment to Contractor for materials stored off site is discouraged. Where circumstances indicate that the Owner's best interest is served by off-site storage, the Contractor shall make written request to the Architect for approval to include such material costs in his next progress payment. The Contractor's request shall include the following information:

.1 A list of the fabricated materials consigned to the Project (which shall be clearly identified), giving the place of storage, together with copies of invoices and reasons why materials cannot be delivered to the site.
.2 Certification that items have been tagged for delivery to the Project and that they will not be used for another purpose.
.3 A letter from the Bonding Company indicating agreement to the arrangements and that payment to the Contractor shall not relieve either party or their responsibility to complete the facility.
.4 Evidence of adequate insurance covering the material in storage, which shall name the Owner as additionally insured.
.5 Evidence that the Architect has visited the Contractor's place of storage and checked all items on the Contractor's certificate. Costs incurred by the Architect to inspect material in off-site storage shall be paid by the Contractor.
.6 Subsequent pay requests shall itemize the materials and their cost which were approved on previous pay requests and remain in off-site storage.
.7 When a partial payment is allowed on account of material delivered on the site of the Work or in the vicinity thereof or under possession and control of the Contractor but not yet incorporated therein, such material shall become the property of the Owner, but if such material is stolen, destroyed, or damaged by casualty before being used, the Contractor will be required to replace

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it at his own expense.

.a Subsequent Pay Requests shall itemize the materials and their cost which were approved on previous Pay Requests and remain in off-site storage.

.8 Contractors application for payment shall reflect an equal percentage amount (within 2 - 3 percent) for labor and materials for Work completed. The Architect may adjust applications where labor exceeds materials or where materials exceed labor quantities in the Work completed columns.

.9 If the Contractor disputes a determination by Architect with regard to Certificate of Payment, and during any related dispute resolution, litigation, or other proceeding, the Contractor nevertheless shall continue to prosecute the Work."

9.8 SUBSTANTIAL COMPLETION

9.8.1 After the words "Contract Documents", insert the following: ...."and when all required occupancy permits, if any, have been issued"…..

9.8.3 (Add the following at the end of this paragraph) "At the time the Architect commences the Substantial Completion Inspection, if the Architect discovers excessive additional items requiring completion or correction, the Architect may decline to continue the inspection, instructing the Contractor as to the general classification of deficiencies which must be corrected before the Architect will resume the Substantial Completion Inspection. If the Contractor fails to pursue the Work so as to make it ready for Substantial Completion Inspection in a timely fashion, the Architect shall, after notifying the Contractor, conduct inspections and develop a list of items to be completed or corrected. This list of items shall be furnished to the Contractor who shall proceed to correct such items within 14 days. The Architect will conduct additional inspections as required to determine that the Work is ready for Substantial Completion Inspection. The Architect will invoice the Owner for 1) The cost of inspections between the termination of the initial Substantial Completion Inspection and the commencement of the satisfactory Substantial Completion Inspection, 2) The cost of inspection or review after the 14 day period established for the completion of the list by the Contractor. The Contractor shall reimburse the Owner for such cost, and the Owner may offset the amounts payable to the Architect for such services from the amounts due the Contractor under the Contract Documents."

9.8.4 (Add the following at the end of this paragraph) "The Architect shall stipulate the time for the Contractor to complete all items on the list accompanying the Certificate of Substantial Completion, such time shall not be greater than 45 days. The Contractor shall complete items on the list within the stipulated period. If the Contractor fails to do so, the Owner in its discretion may perform the Work by itself or others and the cost thereof shall be charged against the Contractor. If more than one inspection by the Architect for the purpose of evaluating corrected work is required by the subject list of items to be completed or corrected, it will be performed at the Contractor's expense. In addition, liquidated damages shall accrue as stipulated in Paragraphs 8.4.1 through 8.4.6."

9.8.6 (Add) "The Contractor shall guarantee all work performed under terms of this contract for a minimum period of one (1) year from the date of Substantial Completion of the work."

9.10 FINAL COMPLETION AND FINAL PAYMENT

9.10.2 (Add the following at the end of this paragraph) "The Contractor shall furnish such evidence as may be necessary to show that any out-of-state Subcontractor or supplier has fully met the requirements of payment of taxes as established in any law of the State or local subdivision thereof which may be in effect at the time of final payment. The Owner will require the submission of such proof or evidence before final payment will be approved or made. The following must be submitted to the Architect before approval of final payment:

.1 Affidavit of payment as required under this Paragraph shall be in the form of AIA Document G706 - Contractor's Affidavit of Payment of Debt and Claims.

.2 Release of liens as required under this Paragraph shall be in the form of AIA Document G706A - Contractor's Affidavit of Release of Liens.

.3 Consent of Surety as required under this Paragraph shall be in the form of AIA Document G707 - Consent of Surety Company to Final Payment.

.4 Submit releases and final unconditional waivers of lien from major Subcontractor and supplier.

.5 Submit certification stating that no materials containing asbestos were incorporated into the Work.

.6 Submit certification that all punch list items have been completed."

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ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.1 (Add the following after Paragraph 10.2.1, subparagraph .3):

".4 Protect excavations, trenches, buildings, and grounds from water damage of any sort. Furnish necessary equipment to provide this protection during the life of the Contract. Construct and maintain necessary temporary drainage to keep excavations free of water.

.5 Provide protection for the Work against wind, storms, cold, or heat. At the end of each day's work, cover new work likely to be damaged. If low temperatures make it impossible to continue operations safely in spite of cold weather precautions, cease work and notify the Architect.

.6 Provide shoring and bracing required for safety and for the proper execution of the Work and have same removed when the Work is completed.

.7 Protect, maintain, and restore benchmarks, monuments, and other reference points affected by this work. If benchmarks, monuments, or other reference points are displaced or destroyed, the benchmarks, monuments, and/or reference points shall be re-established and markers reset under the supervision of a licensed surveyor, who shall furnish certificates of his work."

10.2.9 (Add) "The Contractor acknowledges that the safety of the Owner's students, employees, and guests is of the utmost importance. The Contractor will take no action which would jeopardize the safety of the Owner's students, employees, or guests and, without the Owner's written approval, shall take no action which would interfere with the Owner's activities."

10.2.10 (Add) "The structure is designed to be self-supporting and stable after the Work is fully completed. Except as otherwise provided in 4.3.1 with respect to certain sequencing, it is solely the Contractor's responsibility to determine erection procedures and sequence, and to insure the safety of the building and its component parts during erection. This includes, but is not limited to, the addition of whatever temporary bracing, guys, or tie-downs might be necessary. Such material shall be removed and remain the Contractor's property after completion of the Work."

10.2.11 (Add) "Asbestos products of any kind are not allowed in this Project."

10.5 (Add) "PROJECT SAFETY PROGRAM"

10.5.1 (Add) "Each Contractor will develop a written safety and health plan for the Project ("Plan"), applicable to all Contractors and their Subcontractors and suppliers, regardless of tier, and will designate an individual on its staff, who will have responsibility to implement the Plan ("Project Safety Coordinator"). Such implementation will include inspections of the Project Site at least once each week during major construction activity, and notification of employers of hazardous conditions and noncompliance with the Plan. The Plan will conform to all OSHA statutory or regulatory requirements now or hereafter in effect. Each Contractor will provide a copy of the Plan to the Architect for reference."

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE AND BONDS

11.1.1 After the word "companies" in Line 4, add the following Phrase. . . "Rated A++, A+, A, or A- by Best Insurance Reports and ". . .

11.1.1 (After the phrase "Contract Documents" in Line 6 add the following:)

".1 Liability insurance shall include all major divisions of coverage and be on a comprehensive basis including:

a. Premises' Operations (including X, C, and U coverages as applicable)
b. Owner's and Contractor's Protective
c. Products and Completed Operations
d. Contractual - including specific provisions for the Contractor's obligations under Paragraph 3.18
e. Any owned, non-owned, and hired motor vehicles
f. Broad Form Property Damage including Completed Operations
g. Personal Injury Liability, coverages A, B, and C, with Fellow Employee Exclusion deleted
h. Stopgap liability for $100,000.00 limit.

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i. Umbrella Excess Liability. Minimum limit of $2,000,000.00, except that if the initial Contract Sum is $300,000 or less, the Contractor does not have to provide umbrella excess liability coverage.
j. An endorsement (G2010) including the Owner as an additional insured.

.2 The Contractor's Commercial Liability Insurance shall be written on an occurrence basis, if reasonable available. However, if the general liability coverages are provided by a Commercial Liability policy on a claims-made basis, the policy date or retroactive date shall predate the contract; the termination date of the policy or applicable extended reporting period shall be no earlier than two years after the termination date of coverages required to be maintained after final payment, certified in accordance with paragraph 9.10.2.

.3 The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits."

.4 "The insurance required by paragraph 11.1.1 shall be written for not less than the following, or as required by law, whichever is greater."

".1 Workers' Compensation:
a. State: Statutory
b. Applicable Federal (e.g., Longshoremen's): Statutory
c. Employer's Liability: Statutory

.2 COMPREHENSIVE GENERAL LIABILITY INSURANCE INCLUDING CONTRACTUAL LIABILITY INSURANCE AGAINST THE LIABILITY ASSUMED HEREIN ABOVE, and including CONTRACTORS' PROTECTIVE LIABILITY INSURANCE if the Contractor sublets to another all or any portion of the Work, with the following minimum limits:
a. $2,000,000.00.

.3 COMPREHENSIVE AUTOMOBILE LIABILITY INSURANCE covering all owned, non-owned, and hired automobiles used in connection with the Work, with the following minimum limits:
a. Bodily injury (including death) and property damage with a combined single limit of $1,000,000.00.
b. The Contractor shall maintain the foregoing coverage for not less than the duration of the warranty period. The foregoing policy limits may be provided in conjunction with an umbrella policy. The Contractor shall continue to provide evidence of coverage to the Owner on an annual basis during the aforementioned period."

.5 "The Contractor shall submit to the Architect a copy of Certificate of Insurance for the Architect's review and the Owner's approval prior to commencement of the Work, and thereafter upon renewal or replacement of each required policy of insurance. The form of certificate preferred is AIA Document G705, Certificate of Insurance of Accord Form 25 S. Certificates shall include each and every type of coverage specified. Such certificates shall name the Owner, the Architect, their respective board members, employees, agents, and consultants (and their consultants employees and agents) as additional insureds, and shall contain the following statement: It is hereby agreed that the Owner and the Architect will be notified 60 days prior to the cancellation of, expiration of, material alteration of, and/or the election not to renew any insurance policy evidenced by this certificate."

.6 "The Contractor shall require all Subcontractors to provide Workers' Compensation, Comprehensive General Liability, and Automobile Liability Insurance with the same minimum limits specified herein."

.7 "The Contractor shall not commence work under the Contract until he has obtained all insurance required under this heading and such insurance has been approved by the Owner; no such work shall be commenced until the Contractor has filed with the Architect 2 copies of the necessary certificates evidencing that all required insurance in the requisite amounts, placed with satisfactory carriers, has been obtained. Should any coverage approach expiration during the contract period, it shall be renewed prior to its expiration date and certificates again filed with the Architect. Failure to renew and file new certificates with the Architect shall be just cause to withhold periodic payment request until these requirements are met. All insurance shall be maintained in full force and effect until the Contract has been fully and completely performed."

11.1.2.1 (Add) "All performance bonds if required shall name the Owner as Obligee and shall include the following

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conditions:

.1 Each selected Bidder shall provide a bond covering the faithful performance of the Contract. Bond shall be in the amount of 100% of the Principal's bid plus accepted add alternates stated in dollars and cents. A percentage is NOT acceptable.

.2 For bidders who provided the Bid Guaranty and Contract Bond with their bid, their form of bond shall be the Bid Guaranty and Contract Bond as described in the Instructions to Bidders. (Bid Guaranty and Contract Bond Form is attached).

.3 Bidders who provided a certified check, cashier's check, or irrevocable letter of credit as bid security shall furnish and pay for a Contract Bond in accordance with Ohio Revised Code Section 153.57. The Owner shall be named as Obligee on the Contract Bond.

.4 Contract Bond shall be supported by credentials showing the power of attorney for the attorney-in-fact of the Surety.

.5 The Bid Guaranty and Contract Bond and, if used, the Contract Bond, shall be signed by an authorized agent of an acceptable surety bonding company and by the bidder. The bond shall be issued by a surety company authorized by the Ohio Department of Insurance to transact business in the State of Ohio. Provide certification as described in the Instructions to Bidders. It is essential that the bond be issued by a surety company which can adequately demonstrate a record of competent underwriting, efficient management, adequate reserves, and soundness of investments.

.6 Bond(s) shall be executed on a form specifically meeting all provisions of the Ohio Revised Code Section 153.57 and others as applicable. Said conformance shall be specifically noted clearly on face of the bond.

.7 Furnish, along with the Bond, a Certificate of Compliance from the State of Ohio Superintendent of Insurance certifying that the surety is authorized to transact business in the State of Ohio."

11.2 Owner's Insurance

11.2.1.1 (Add) "Unless specifically stated otherwise in the Agreement or other Contract Documents, the Owner shall maintain property insurance on the Project. The Owner also shall maintain all-risk "Builder's Risk" insurance, in an amount of 100 percent of the insurable value of the entire structure, on which the Work of this Contract is to be done, against "loss or damage." Such insurance shall be on the "estimated completed value form" including items of labor and materials connected therewith, including materials in place or stored on the site of the structure insured, which are to be used as part of the permanent construction including surplus materials, shanties, protective fences, or temporary structure, miscellaneous materials and supplies, incident to the work and such scaffolding, staging, towers, forms, and equipment as are now owned or rented by the Contractor, the cost of which is included in the cost of the Work. The policy shall insure the Owners and shall also include the interest of the Contractors during course of construction until completed and accepted by the Owners. Certificates for this insurance shall name the Architect as additionally insured. The Owner will make the property insurance policy available for inspection and copying by the Contractor. This insurance is not intended to cover and will not cover machinery, tools, and equipment which will not be a permanent part of the Project. The Contractor shall bear the entire risk of loss with respect to such machinery, tools, and equipment. Any loss insured under Paragraph 11.2 is to be adjusted with the Owner and made payable to the Owner as trustee for the insureds, as their interests may appear. The Owner, as trustee, will have the power to adjust and settle any loss with its insurers."

11.2.1.2 (Add:) "The above policies in §11.2 shall carry a deductible up to a maximum of $5,000 and the deductible shall be paid for by the Contractor."

11.2.1.3 (Add) "The above policies in §11.2 shall name the following as additionally insured:
.1 Architect, its employees, its consultants, and their employees."

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION
(Delete the text in this paragraph and replace with the following) "Within 48 hours after written notice from the Architect, or the Owner (except such period shall be 7 days when notice is given after final payment) that the work does not conform to the Contract Documents, or immediately upon oral notice, if

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the non-conformance constitutes a threat to the safety of persons or property, the Contractor, without waiting for the resolution of disputes that may exist, i) shall commence to correct such non-conformance, ii) shall thereafter use its best efforts to correct such non-conformance to the satisfaction of the Architect and the Owner, and iii) except where an extension of time is granted in writing by the Owner, shall complete necessary corrections so that the non-conformance is eliminated to the satisfaction of the Architect, and the Owner within 7 days of such notice. The Contractor shall bear all costs of correcting the non-conformance, including additional testing and inspections and additional service fees of the Architect. The notice provided for in this paragraph 12.2.1 may be given at any time. It is the intent that the obligations under this paragraph 12.2.1 shall continue to apply after final completion and final payment."

12.2.2 AFTER SUBSTANTIAL COMPLETION Delete this paragraph and 12.2.2.1 in its entirety.

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

13.1.2 (Add) "Jurisdiction. Any suit, which may be brought to enforce any provision of this Agreement or any remedy with respect hereto, shall be brought in the Common Pleas Court, Hamilton County, Ohio, and each party hereby expressly consents to the jurisdiction of such court."

13.4 TESTS AND INSPECTIONS

13.4.4 (Delete the text in this paragraph and replace with the following) "Certificates of inspection, testing, or approval, as required by Paragraphs 13.4.1 or 13.4.2, shall be secured by the Contractor using an independent agency, subject to the approval of the Architect, , and Owner. The independent agency shall complete field work, testing, and prepare the test reports, logs, and certificates promptly; and deliver the required number of copies directly to the Architect."

13.5 INTEREST Delete this Paragraph in its entirety. References to Paragraph 13.5 elsewhere in the Contract Documents shall also be deleted.

13.6 (Add) “CONSTRUCTION”

13.6.1 (Add) “The parties acknowledge that each party has reviewed this Agreement and the other Contract Documents and voluntary entered into this Agreement.”

13.7 (Add) “APPROVALS”

13.7.1 (Add) “Except as may be expressly provided herein, the approvals and determinations of the Owner, or Architect will be subject to the sole discretion of the respective person and be valid and binding on the Contractor, provided only that they be made in good faith, i.e., honestly. If the Contractor challenges any such approval or determination, the Contractor will have the burden of proving that it was not made in good faith by a preponderance of the evidence.”

13.8 (Add) “PARTIAL INVALIDITY”

13.8.1 (Add) “If any term or provision of this Agreement is found to be illegal, unenforceable or in violation of any laws, statutes, ordinances, or regulations of any public authority having jurisdiction, then, notwithstanding such term or provision, this Agreement will remain in full force and effect and such term will be deemed stricken; provided this Agreement will be interpreted, when possible, so as to reflect the intentions of the parties as indicated by any such stricken term or provision.”

13.9 (Add) “PROPERTY TAX AFFIDAVIT”

13.9.1 (Add) “The Contractor's affidavit given under Section 5719.024, Ohio Revised Code, is incorporated herein.”

13.10 (Add) “ENTIRE AGREEMENT”

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13.10.1 (Add) "This Agreement and the other Contract Documents constitute the entire agreement among the parties with respect to their subject matter and supersede all prior and contemporaneous, oral or written, agreements, negotiations, communications, representations, and understandings with respect to such subject matter, and no person is justified in relying on such agreements, negotiations, communications, representations, or understandings."

13.1 (Add) "SCHOOL DISTRICT RESOLUTION"
13.11.1 (Add) "No alcohol, drugs, firearms or smoking is permitted on property owned by the School District. Compliance with all Owner policies covering these items is mandatory."

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

(Delete the entire contents of this Article (14.1 through 14.4) and replace with the following:

14.1 (Add) "DEFAULT OF THE CONTRACTOR"

14.1.1 (Add) "Events of Default; each of the following constitutes an event of default of the Contractor:
.1 The failure of the Contractor, i) to perform its obligation under the Contract Documents or under the Contract Documents pertaining to other agreement which the Contractor may have with the Owner and to proceed to commence to correct such failure within 48 hours after written notice thereof from the Owner, or the Architect or such lesser time as is provided in the Contract Documents, or ii) thereafter to use its best efforts to correct such failure to the satisfaction of the Owner, or, iii) except where an extension of time is granted in writing by the Owner, to correct such failure within 30 days after written notice thereof.
.2 The failure of the Contractor to pay its obligations as they become due, or the insolvency of the Contractor."

14.1.2 (Add) "Owner's Remedies; upon the occurrence of an event of default the Owner will have the following remedies, which will be cumulative:
.1 To order the Contractor to stop the Work or part of it, in which case the Contractor will do so immediately;
.2 To perform through others all or part of the Work remaining to be done and to deduct the cost thereof from the unpaid balance of the Contract Price;
.3 To terminate this Agreement and take possession, for the purpose of completing the Work or part of it, materials, equipment, scaffolds, tools, appliances, and other items belonging to or possessed by the Contractor, of which the Contractor hereby transfers and assigns to the Owner for such purpose, and to employ a person or persons to complete the Work, including the Contractor's employees, and the Contractor will not be entitled to receive further payment until the Work is completed;
.4 Other remedies which the Owner may have at law or in equity or otherwise under the Contract Documents."

14.1.3 (Add) "Payments Due Contractor: If the unpaid balance of the Contract Sum exceeds the cost of finishing the Work, including compensation of the Architect's additional services and costs, expenses, or damages incurred by the Owner as a result of the event of default, including attorney's fees and the administrative expensive of the Owner's staff, such excess will be paid by the Contractor. If such costs exceed the unpaid balance, the Contractor will pay the difference to the Owner. The amounts to be paid by the Owner or the Contractor will be certified by the Architect, and such certification will be the final determination of the amount owed, except for sums coming due thereafter. The obligations under this paragraph will survive the termination of this Agreement."

14.2 (Add) "DEFAULT OF THE OWNER"

14.2.1 (Add) "Events of Default; except of the failure to pay the Contractor which will be subject to the terms of the General Conditions and Supplementary General Conditions of the Contract, the following constitutes the exclusive event of default of the Owner:
.1 The failure of the Owner to perform its obligations under the Contract Documents and to correct such failure within 90 days after written notice thereof from the Contractor."

14.2.2 (Add) "Contractor's Remedies; upon the occurrence of an event of default by the Owner, unless the Owner admits in writing that it is in default, except as expressly provided in the General Conditions or the Supplementary Conditions of the Contract, the Contractor's sole and exclusive remedy will be to submit the dispute to the Architect for its decision under Article 4.4 of the General and Supplementary

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Conditions of the Contract for the Project, and then provided the Contractor is entitled to do so under the terms of the Contract Documents to litigate the dispute. If the Owner admits in writing that it is in default, then the Contractor will be entitled to remedies which it would otherwise have at law or in equity."

14.3 (Add) "TERMINATION FOR THE CONVENIENCE OF THE OWNER"

14.3.1 (Add) "The Owner may, in its discretion and without cause, by written notice to the Contractor terminate the Contract for the Owner's convenience."

14.3.2 (Add) "Upon receipt of a written notice from the Owner terminating the Contract without cause and for the Owner's convenience, the Contractor will i) immediately cease performing the Work, unless otherwise directed by the Owner, in which case the Contractor will take the action directed by the Owner, ii) take reasonable and necessary action to protect and preserve the Work, and iii) unless otherwise directed by the Owner, terminate agreements with Subcontractors and suppliers."

14.3.3 (Add) "If the Contract is terminated without cause and for the Owner's convenience and there exists no event of the Contractor's default, as defined in Paragraph 14.1 of these Supplementary Conditions, the Owner will pay the Contractor, i) for Work performed under the Contract up to the date the notice of termination is received by the Contractor at the rates for Work performed under the Contract, including overhead and profit up to the date of termination, ii) for Work performed at the direction of the Owner on and after the date on which the notice of termination is received by the Contractor, as determined by the procedures applicable to Change Orders under paragraph 7.3.3, iii) for Work necessary to protect and preserve the Work, as determined by the procedures applicable to Change Orders under paragraph 7.3.3, iv) the reasonable and necessary costs of terminating the Contractor's agreements with Subcontractors and suppliers, and other costs incurred by the Contractor directly as a result of the termination of the Contract."

14.3.4 (Add) "If the Contract is terminated without cause and for the Owner's convenience and there exists an event of the Contractor's default, as defined in Paragraph 14.2 of these Supplementary Conditions, the Contractor will be entitled to receive only such sums as it would be entitled to receive following the occurrence of an event of default under Paragraph 14.2."

14.3.5 (Add) "The termination of the Contract shall be with or without prejudice to rights or remedies which exist at the time of termination."

ARTICLE 15: CLAIMS AND DISPUTES

15.1.6 CLAIMS FOR ADDITIONAL TIME

15.1.6.1 (Delete the text in this paragraph and replace with the following) "If claims for additional time are submitted by the Contractor and are substantiated as per contract requirements, a change order extending contract time only will be issued by the Architect. However, under no circumstances will the Contractor be entitled to any damages or additional compensation related to or for contract time extensions or delays."

15.1.6.2 (Delete the text in this paragraph and replace with the following) "Claims for additional time based on adverse weather conditions will be considered only if the Contractor provides evidence that monthly precipitation and temperature averages vary significantly from those of the norm. The norm shall be defined as those monthly precipitation and temperature averages indicated by the National Oceanic and Atmospheric Administration averaged over the past 30 years, at the location closest to the site. Weather conditions will be considered for all months affecting the critical path, and determined once the critical path is no longer affected by weather conditions. Both, months with conditions better than the norm, and those with adverse conditions will be considered in summation of the delay. Notifications of delay to be in accord with related articles of General Conditions."

15.2 INITIAL DECISION
In paragraphs 15.2.1 through 15.2.8, replace the words "Initial Decision Maker" each and every time with the words "Architect".

15.2.5 In the last sentence, delete the phrase "mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution." with the word "litigation".

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15.2.6 Delete this paragraph in its entirety.

15.2.6.1 Delete this paragraph in its entirety.

15.3 MEDIATION
Delete Paragraph 15.3 in its entirety. Mediation is not applicable to this Project.

15.4 ARBITRATION
Delete Paragraph 15.4 in its entirety. Arbitration is not applicable to this Project.

(Add) "ARTICLE 16: EQUAL OPPORTUNITY"

16.1 (Add) "POLICIES OF EMPLOYMENT"

16.1.1 (Add) "The Contractor shall not, and it will ensure that its Subcontractors, regardless of tier, shall not discriminate against employee or applicant for employment because of race, religion, color, sex, or national origin. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination."

16.1.2 (Add) "The Contractor shall not, and it will ensure that its Subcontractors, regardless of tier, shall, in solicitations or advertisements for employees placed by them or on their behalf, state that qualified applicants will receive consideration for employment without regard to race, religion, color, sex, or national origin."

END OF SECTION 00 73 01

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DOCUMENT 00 73 03 - DRUG-FREE WORKPLACE CERTIFICATION

(1) Contractor is required to be enrolled and in good standing in the Ohio Bureau of Workers' Compensation (BWC) Drug-Free Workplace Program (DFWP) or an equivalent BWC approved DFWP throughout the entire Project, in accordance with Ohio Revised Code Section 153.03-153.031, including the placement of its employees in a pool with a random drug testing rate of at least 5%.

(2) Each contractor shall require all subcontractors with whom the contractor is in contract for the public improvement to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in Section 153.03 of the Ohio Revised Code, including the placement of its employees in a pool with a random drug testing rate of at least 5%, prior to a subcontractor providing labor at the project site of the public improvement.

(3) Each subcontractor shall require all lower-tier subcontractors with whom the subcontractor is in contract for the public improvement to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in Section 153.03 of the Ohio Revised Code, including the placement of its employees in a pool with a random drug testing rate of at least 5%, prior to a lower-tier subcontractor providing labor at the project site of the public improvement.

(4) Failure of a contractor to require a subcontractor to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in Section 153.03 of the Ohio Revised Code, including the placement of its employees in a pool with a random drug testing rate of at least 5%, prior to the time that the subcontractor provides labor at the project site will result in the contractor being found in breach of the contract and that breach shall be used in the responsibility analysis of that contractor or the subcontractor who was not enrolled in a program for future contracts with the state for five years after the date of the breach."

(5) Failure of a subcontractor to require a lower-tier subcontractor to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in Section 153.03 of the Ohio Revised Code, including the placement of its employees in a pool with a random drug testing rate of at least 5%, prior to the time that the lower-tier subcontractor provides labor at the project site will result in the subcontractor being found in breach of the contract and that breach shall be used in the responsibility analysis of that subcontractor or the lower-tier subcontractor who was not enrolled in a program for future contracts with the state for five years after the date of the breach.

Complete and submit certification form on next page:

DRUG FREE WORKPLACE PROGRAM CERTIFICATION

Project Name and Location: _____

Contractor Name: _____

The above referenced Contractor hereby certifies that it is enrolled and in good standing in the Ohio Bureau of Workers' Compensation (BWC) Drug-Free Workplace Program (DFWP) or an equivalent BWC approved DFWP in accordance with the requirements of Ohio Revised Code Section 153.03-153.031, including the placement of its employees in a pool with a random drug testing rate of at least 5%.

_____
Contractor Signature Date

_____
Name/Title (Print or Type)

END OF DOCUMENT 00 73 03

DOCUMENT 00 73 04 - WAIVER OF ESCROW AGREEMENT

The undersigned Contractor has entered into a contract with the **Board of Education of the Winton Woods City School District** (the "School District") for certain improvements as described below. In connection therewith, the Contractor and the School District acknowledge that the School District is obligated by Sections 153.12 and 153.14 of the Revised Code to retain a certain percentage of funds that would otherwise be paid to the Contractor until the work is completed. However, the Contractor hereby waives any and all rights that it may have relating to the establishment of a separate escrow account for the deposit of the retained funds. The Contractor also waives any and all claims it may have to interest on that separate escrow account under Section 153.63(D) of the Revised Code or other provisions of law, and agrees to accept from the District in lieu thereof the net income and earnings on the investment of the retained funds by the School District. In consideration of the waivers herein contained, the School District agrees to keep a separate accounting of the net income and earnings on the investment of the retained funds and pay such income and earnings to the Contractor when the retained funds are ultimately paid to the Contractor.

Printed Name of Contractor	Bid Package
Signature and Title of Authorized Officer	Contract Date

Dated:_____, 20____

BOARD OF EDUCATION WINTON WOODS CITY SCHOOL DISTRICT

By: _____
Treasurer, Board of Education

Dated:_____, 20_____

END OF DOCUMENT 00 73 04

DOCUMENT 00 73 42 - CONTRACT PROVISIONS FOR NON-FEDERAL ENTITY CONTRACTS UNDER FEDERAL AWARDS

The Education Department of General Administrative Regulations (EDGAR) are the federal regulations that govern all federal grants awarded by the U.S. Department of Education on or after December 26, 2014 to local districts (LEAs) and charters including State-administered programs. All recipients of federal grant dollars must comply with these rules. All provisions provided below are hereby incorporated by reference into the Owner-Contractor Agreement ("Agreement") and by entering into this Agreement, Contractor certifies the following:

Appendix II to Part 200 Contract Provisions for Non-Federal Entity Contracts Under Federal Awards

(A) Contracts for more than the simplified acquisition threshold, currently set at $250,000, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.

Pursuant to Rule (A) above, the Owner reserves all rights and privileges under the applicable laws and regulations with respect to this procurement process in the event of breach of contract by either party.

(B) All contracts in excess of $10,000 must address termination for cause and for convenience by the non-Federal entity including the manner by which it will be effected and the basis for settlement.

Pursuant to Rule (B) above, Owner reserves the right to terminate any agreement resulting from this procurement process pursuant to Article 14 of Section 00 73 01 - Supplementary General Conditions.

(C) Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

Pursuant to Rule (C) above, this provision is hereby incorporated by reference into the Agreement.

(D) Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of $2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or sub-recipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

Pursuant to Rule (D) above, Contractor will follow all applicable Davis-Bacon Act provisions.

(E) Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission

of intelligence.

Pursuant to Rule (E) above, Contractor certifies that Contractor will follow all applicable provisions of the Contract Work Hours and Safety Standards Act during the term of the Agreement.

(F) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of "funding agreement" under 37 CFR § 401.2 (a) and the recipient or sub-recipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that "funding agreement," the recipient or sub-recipient must comply with the requirements of 37 CFR Part 401, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

Pursuant to Rule (F) above, Contractor certifies that during the term of the Agreement, Contractor agrees to comply with all applicable requirements referenced in Rule (F) above.

(G) Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended - Contracts and sub-grants of amounts in excess of $150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

Pursuant to Rule (G) above, Contractor certifies that during the term of the Agreement, Contractor agrees to comply with all applicable requirements as referenced in Rule (G) above.

(H) Debarment and Suspension (Executive Orders 12549 and 12689) - A contract award (see 2 CFR 180.220) must not be made to parties listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

Pursuant to Rule (H) above, Contractor certifies that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation by any federal department or agency.

(I) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352) - Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

Pursuant to Rule (I) above, as applicable, Contractor agrees to file all certifications and disclosures required by, and otherwise comply with, the Byrd Anti-Lobbying Amendment (31 USC 1352).

Record Retention Requirements

Contractor certifies that during the term of the Agreement, Contractor will comply with the record retention requirements detailed in 2 CFR § 200.333. The Contractor further certifies that all records will be retained as required by 2 CFR § 200.333 for a period of three years after grantees or sub-grantees submit final expenditure reports or quarterly or annual financial reports, as applicable, and all other pending matters are closed.

Energy Policy and Conservation Act Compliance

To the extent applicable, Contractor certifies that during the term of the Agreement, Contractor will comply with the mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

Buy American Provisions Compliance

To the extent Contractor has agreed to comply with applicable provisions of the Buy American Act with a particular public entity, Contractor certifies that Contractor is in compliance with all applicable provisions of the Buy American Act. Purchases made in accordance with the Buy American Act shall follow the applicable procurement rules calling for free and open competition.

Recovered Materials (2 C.F.R. § 200.322)

Contractor agrees to the extent practical it complies with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act.

Access to Records (2 C.F.R. § 200.336)

Contractor agrees that duly authorized representatives of the Agency shall have access to any books, documents, papers and records of Contractor that are directly pertinent to Contractor's discharge of its obligations under the Contract for the purpose of making audits, examinations, excerpts, and transcriptions. The right also includes timely and reasonable access to Contractor's personnel for the purpose of interview and discussion relating to such documents.

Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment

Contractor, nor its subcontractors shall provide or install equipment, services, or systems that uses "covered telecommunications equipment or services" as a substantial or essential component of any system, or as critical technology as pad of any system. As described in Public Law 115-232, section 889, "covered telecommunications equipment" is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities); video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities); telecommunications or video surveillance services provided by such entities or using such equipment; or telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

Complying with Federal, State, and Local Laws

Contractor agrees to comply with federal, state, and local laws, rules, regulations, and ordinances, as applicable. It is further acknowledged that Contractor certifies compliance with provisions, laws, acts, regulations, etc. as noted above.

This certification shall be effective through the term of the Contractor's Agreement.

END OF DOCUMENT 00 73 42

DOCUMENT 00 73 43 – DAVIS-BACON CONTRACT PROVISIONS

In accordance with 29 CFR Part 5, the following Definitions and Contract Provisions are applicable to the Agreement and are hereby incorporated into the Contract Documents. In the event of a conflict between these Definitions and Contract Provisions and any other provision of the Agreement, the stricter requirement applies.

Definitions

The definitions set forth in 29 C.F.R. § 5.2 apply to the Contract Provisions contained herein. Such definitions are to be read in addition to, and not in exclusion of, any definitions set forth in the Agreement, General Conditions, or other Contract Documents.

Contract Provisions

(a) The following clauses are hereby incorporated into the Agreement:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 C.F.R. Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in §5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii) (A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of

the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The Federal Agency or Owner shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, the Federal Agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 C.F.R. § 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii) (A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Federal Agency if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the Federal Agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 C.F.R. § 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at http://www.dot.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the Federal Agency if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or

owner, as the case may be, for transmission to the Federal Agency, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 C.F.R. Part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 C.F.R. Part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 C.F.R. Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the Federal Agency or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal Agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 C.F.R. § 5.12.

(4) Apprentices and trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid

in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 C.F.R. § 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 C.F.R. Part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 C.F.R. Part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 C.F.R. § 5.5(a)(1) through (10) and such other clauses as the Federal Agency may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 C.F.R. § 5.5.

(7) Contract termination: debarment. A breach of the contract clauses in 29 C.F.R. § 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 C.F.R. § 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 C.F.R. Parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 C.F.R. Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 C.F.R. § 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 C.F.R. § 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(b) Contract Work Hours and Safety Standards Act. If the Contract Sum is in an amount in excess of $100,000, and the Work is subject to the overtime provisions of the Contract Work Hours and Safety Standards Act, the follow provisions shall apply. Additionally, the Construction Manager shall include these provisions in full in all Subcontracts in excess of $100,000 which are subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. The provisions in these clauses are in addition to the clauses provided above in subsection (a). As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of $27 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The Federal Agency or the Owner shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

(c) In addition to the clauses contained in paragraph (b), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 C.F.R. § 5.1, the Construction Manager and its Subcontractors shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the records to be maintained under this paragraph shall be made available by the Construction Manager and its Subcontractors for inspection, copying, or transcription by authorized representatives of the Federal Agency and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

(d) Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251- 1387), as amended—Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

(e) Debarment and Suspension (Executive Orders 12549 and 12689)—Contractor warrants that it is not listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), “Debarment and Suspension.” SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

(f) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)—Contractor and any subcontractors certify to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

END OF DOCUMENT 00 73 43

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Services

Phase I ESA's
Phase II Investigations
Asbestos
Energy Efficiency
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Industrial Hygiene
Indoor Air Quality/Mold
Radon
Safety
Training

Asbestos-Containing Materials/Universal-Hazardous Waste Materials Inspection Report

Winton Woods Intermediate School
825 Waycross Road
Cincinnati, Ohio 45240

Prepared for:

Mr. Steve Denny
Winton Woods Local School District
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513-619-2402

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Asbestos Hazard Evaluation Specialist #ES34509

Michelle Paraniuk, M.S., President

July 2019

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1.0 Executive Summary

1.1 Background

m.a.c. Paran Consulting Services, Inc. performed a pre-renovation asbestos inspection at Winton Woods Intermediate School, 825 Waycross Road, Cincinnati Ohio. The objectives of the inspection were to; (1) identify, by type and location, friable and on-friable asbestos-containing materials [ACM] throughout the structure; (2) assess the current condition of the ACM identified; (3) provide estimated quantities of ACM; and (4) inventory universal/hazardous wastes. The inspections were conducted by Mr. Samuel C. Prather, certified Ohio Asbestos Hazard Evaluation Specialists (License #ES36284) and Mr. Paul Cordy, certified Ohio Asbestos Hazard Evaluation Specialists (License #ES34509) in July 2019.

1.2 Inspection Results

The following is a summary of the materials confirmed by the laboratory, or assumed, to contain >1% asbestos. Please note that the quantities provided in this summary are approximate amounts, and should be verified by an abatement contractor prior to the onset of removal activities.

- **9" Floor Tile/Mastic** - Approximately 32,580 square feet of asbestos-containing 9" floor tile and mastic were identified throughout the building. The materials are in a non-friable condition.

- **12" Floor Tile/Mastic** - Approximately 10,585 square feet of asbestos-containing 12" floor tile and mastic were identified throughout the building. The materials are in a non-friable condition.

- **12" Cream with Black Dots Floor Tile** - Approximately 80 square feet of asbestos-containing 12" cream floor tile with black dots was identified in hallway 110. The material is in a non-friable condition.

- **Cementitious Fitting Insulation** - Approximately 926 asbestos-containing cementitious fittings between sections of fiberglass pipe insulation were identified, or assumed, throughout the building. The material is in good condition.

- **Mastic on 12" Acoustical Ceiling Tile** - Approximately 571 square feet of 12" acoustical ceiling tile with asbestos-containing mastic was identified in rooms 146, 146A, and 146B. The material is in a non-friable condition.

- **Window Bedding** - Approximately 1,944 linear feet (81 windows) of asbestos containing window bedding was identified on the exterior and interior of the metal windows located throughout the building. The material is in a non-friable condition.

- **Black Cove Base Mastic** - Approximately 7,436 linear feet of asbestos-containing black cove base mastic was identified throughout the building. The material is in a non-friable condition.

- **Vibration Gasket** - Approximately 40 square feet of asbestos-containing vibration gasket material was assumed in room 138 and the hallway 142. The material is in a non-friable condition.

- **Vapor Barrier Beneath Gymnasium Floor** - Approximately 6,935 square feet of asbestos-containing vapor barrier was assumed to be located beneath the wood gymnasium floor. The material is in an unknown condition.

- **Chalk Board Adhesive** - Approximately 1,844 square feet of asbestos-containing chalk board adhesive was assumed to be located throughout the building. The material is in an unknown condition.

- **Roofing Material** - Approximately 81,200 square feet of roofing material located on the exterior of the building was assumed to contain asbestos. The material is in a non-friable condition.

Note 1: While care was taken during the inspection to identify all asbestos-containing materials, additional materials may be located within non-accessible areas of the structure (e.g., behind walls, above intact ceilings, inside concealed pipe chases, etc.). If, through renovation or demolition these materials are discovered, they should be treated as asbestos-containing until further testing proves otherwise.

Note 2: Approximately 6,232 square feet of drywall with joint compound containing <1% asbestos was identified throughout the building. The composite of the drywall and joint compound is also <1% asbestos.

Note 3: Approximately 48 square feet of roof drain insulation containing <1% asbestos was identified throughout the building.

Note 4: Approximately 1,944 linear feet (130 square feet) of window caulking containing <1% asbestos was identified throughout the building.

Note 5: When access into block walls is permitted, an inspection for the presence of asbestos-containing vermiculite should be conducted.

1.3 Universal/Hazardous Waste Inspection Results

The universal/hazardous waste inventory is provided in Appendix C.

2.0 Inspection Procedures

2.1 General Asbestos Inspection and Sampling Procedures

The inspection was performed following a modified protocol of the EPA Asbestos Hazard Emergency Response Act (40 CFR 763.90) commonly known as "AHERA". Although originally required only for public and private school structures housing kindergarten through 12th-grade classes, it has become the accepted industry standard for conducting asbestos investigations in all types of structures. Most recently, the Occupational Safety and Health Administration revised its Asbestos in Construction Industry standard (29 CFR 1926.1101) to reference AHERA as the required method of conducting asbestos inspections in all public and commercial structures.

The vast majority of physically accessible spaces within the structure were accessed and inspected for suspect asbestos-containing materials. The Inspector then grouped suspect materials into homogeneous areas for sampling. A homogeneous area consists of materials with like appearance, color, texture, and application date. A physical assessment (visual observation and touching the material) was also made of the current condition and degree of friability for each identified material (a material is considered friable if it can be crumbled using hand pressure). A list of homogeneous areas identified for this assessment is included on the Bulk Sample Summary Table.

The Inspector assessed all identified asbestos-containing materials. The inspection encompassed both friable and non-friable materials. The Inspector then assumed that the specific material remained homogeneous (based upon the material's appearance and application) throughout the structure. In situations where materials appeared to alternate between asbestos containing and non-asbestos containing, the Inspector looked for visible differences between materials. If differences were not apparent, the Inspector made a professional decision to err on the side of conservatism and assumed that all materials were asbestos-containing.

The Inspector made every effort to locate all asbestos-containing materials identified during the limited inspection; however, should unidentified suspect asbestos-containing materials be discovered, please contact m.a.c. Paran Consulting Services, Inc. for assistance in material identification.

2.2 Method of Sampling and Analysis

2.2.1 Bulk Sample Collection Methods

To avoid disturbing suspected asbestos-containing materials more than necessary and minimize the potential release of asbestos fibers, the Inspector performed bulk sampling in accordance with the industry accepted procedures outlined in the current EPA Guidance Document and the AHERA sampling protocol. Each sample collected was pre-wetted and obtained using a clean coring tool, utility knife, or other appropriate tool. Each sample was then placed in a clean, sealable vial and labeled with a unique sample identification number. Care was taken to obtain a sample that was representative of all layers of a material. To avoid cross-contamination, the tools used for sample collection were thoroughly cleaned before collecting the next sample. If requested, the sample site was labeled with a pre-printed adhesive-backed sample identification tag bearing the corresponding sample identification number. Pertinent sample information was recorded on a standardized bulk sample log sheet including the date of inspection, name of the Inspector, a brief description and the location of the sample, and the type of material sampled (e.g., thermal systems insulation).

2.2.2 Analysis of Bulk Samples

Bulk samples were analyzed for asbestos content by Polarized-Light Microscopy (PLM) and dispersion staining (Method Reference: EPA/600/R-931/116). This analytical method, which EPA currently recommends, for the determination of asbestos in bulk samples, can be used for qualitative identification of six morphologically different types of asbestos fibers: chrysotile, amosite, crocidolite, anthophyllite, tremolite, and actinolite asbestos.

PLM analysis requires the microscopist to take a portion of the sample and treat it with an oil of a specific refractive index. This prepared slide is then subjected to a variety of tests while being viewed under varying polarizations of light. Each asbestos type displays unique characteristic when subjected to these tests. Percentages of the identified types of asbestos are determined by visual estimation.

For samples containing low concentrations of asbestos, the Inspector may choose to have the laboratory perform point count analysis. This additional step is employed to more accurately determine the percent of asbestos that is in the material being sampled. Using the point counting procedure, eight mounts are made by dispersing eight sub-samples of the bulk sample into a suitable fluid. A reticule is placed on the eyepiece of the microscope that superimposes a grid of points over the field of view. Fifty non-empty points are examined for each mount, yielding 400 points, some of which may be identified as asbestos and the rest as non-asbestos material. A simple calculation gives the percentage asbestos; 4 points in 400 would be 1.0%.

2.2.3 Reporting of Analysis Results

The method specifies that the asbestos content in a bulk sample shall be estimated and reported as a finite percentage (rounded to the nearest percent) within the range of 0 to 100. Minute quantities of asbestos in bulk samples may be reported as “trace” (tr) or less than 1 percent. The composition of the bulk sample is reported in percentages of asbestos (i.e., chrysotile, amosite, crocidolite, or other) and non-asbestos (i.e., cellulose, fiberglass, mineral wool, synthetic, or other) components. The original laboratory reports are presented in Appendix A.

2.2.4 Laboratory

Analysis of all suspect asbestos-containing materials was performed by Eurofins CEI Laboratory, 730 SE Maynard Road, Cary NC 27511 using polarized light microscopy. Eurofins CEI successfully participates in, and is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP), administered by the National Institute of Standards and Technology.

2.3 Physical and Hazard Assessment

2.3.1 Physical Assessment Factors

Per AHERA requirements, the Inspector performed a physical assessment of all friable asbestos-containing materials. This involved physically observing and documenting the current condition of each friable material and assessing its potential for future disturbance (or fiber release potential).

The Inspector categorized the materials’ current condition as Good, Fair, or Poor. AHERA protocol is not specific as to how these categories are arrived at, but in general the following guideline is used:

- Good – less than 10% area damage
- Fair – more than 10%, but less than 25% area damage
- Poor – more than 25% area damage

The Inspector then made an assessment of the materials’ potential for future disturbance (or fiber release potential) using the general factors listed in Table 2-1 on the following page. The first three factors focus on the current condition of the asbestos-containing material. Evidence of deterioration, delamination, physical damage, or water damage indicates that fiber release has occurred, is occurring, or is likely to occur in the future. Such evidence is based on the appearance of the material and/or the presence of dislodged or crumbled material in the surrounding area. The first three factors focus on the potential for fiber release due to disturbance or erosion. Surface erosion is likely to occur when asbestos-containing materials are located in air plenums or near forced-air streams. Exposed and easily accessible materials in areas frequented by structure occupants, or subject to mechanical vibrations are more vulnerable to disturbance or damage than materials in other locations.

Table 2-1: Factors for Assessing Potential Fiber Release
Current Condition of Asbestos-Containing Materials
• Evidence of deterioration or delamination from the underlying surface (substrate) • Evidence of physical damage (e.g., presence of debris) • Evidence of water damage
Potential for Future Disturbance, Damage, or Erosion of Asbestos-Containing Material
• Proximity to air plenum or direct airstream • Visibility, accessibility (to structure occupants and maintenance personnel), and degree of activity (air movement, vibration, movement of structure occupants) • Change in structure use

2.3.2 Hazard Assessment Factors

Based upon the physical assessment, friable asbestos-containing materials are then given a hazard rank with corresponding response options to aid the structure owner in prioritizing response actions. The hazard ranks range from 7 – most hazardous, to 1 – least hazardous as shown in Table 2-2 below. The highest rank is reserved for materials that are "significantly damaged" or material that is so extensively damaged that it requires immediate corrective action. Hazard ranks 4 – 6 reflect materials which are "damaged" with rank 6 indicating a high potential for further damage, and rank 5 indicating a moderate potential for damage. Hazard rank 4 denotes that a material has been damaged; however, the potential for any further damage is low. Hazard ranks 1 – 3 are reserved for materials currently in good condition with future disturbance potentials being high, moderate, or low (3, 2, 1, respectively). Non-friable materials are categorized as non-friable.

Table 2-2: Classifications for Hazard Potential of Friable Asbestos-Containing Materials		
Hazard Rank	**Condition**	**Disturbance Potential**
7	Poor	Any
6	Fair	High
5	Fair	Moderate
4	Fair	Low
3	Good	High
2	Good	Moderate
1	Good	Low

2.3.3 Physical and Hazard Assessments of Materials Encountered

The physical and hazard assessments made for all asbestos-containing materials identified during this inspection can be found in Section 4.0 “Inventory of Asbestos-Containing Materials”.

3.0 Bulk Sample Data Summary

The following table presents the results of suspect materials sampled.

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Room 101	Cementitious Fitting Insulation	1	WWI-1	Chrysotile 10%
Room 135D	Cementitious Fitting Insulation	1	WWI-2	Positive Stop Analysis
Room 129	Cementitious Fitting Insulation	1	WWI-3	Positive Stop Analysis
Room 129	Rope Gasket	2	WWI-4	None Detected
Room 129	Rope Gasket	2	WWI-5	None Detected
Hallway 134	Roof Drain Insulation	3	WWI-6	<0.25% Chrysotile¥
Room 134	Roof Drain Insulation	3	WWI-7	<0.25% Chrysotile¥
Room 122	12” Grey with Blue Flecks Floor Tile	4A	WWI-8	None Detected
Room 122	Mastic on HA# 4A	4B	WWI-8	None Detected
Hallway 107	12” Grey with Blue Flecks Floor Tile	4A	WWI-9	None Detected
Hallway 107	Mastic on HA# 4A	4B	WWI-9	None Detected
Room 139	2’x4’ Fissured Ceiling Tile	5	WWI-10	None Detected
Room 142	2’x4’ Fissured Ceiling Tile	5	WWI-11	None Detected
Hallway 108	Black Cove Base Mastic	6	WWI-12	Chrysotile 2%
Room 106	Black Cove Base Mastic	6	WWI-13	Positive Stop Analysis
Room 122	Drywall	7	WWI-14	None Detected

¥ verified by point count analysis

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Hallway 107	Drywall	7	WWI-15	None Detected
Stage	9” Grey Floor Tile	8A	WWI-16	Chrysotile 10%
Stage	Mastic on HA# 8A	8B	WWI-16	Chrysotile 5%
Stage	9” Grey Floor Tile	8A	WWI-17	Positive Stop Analysis
Stage	Mastic on HA# 8A	8B	WWI-17	Positive Stop Analysis
Room 132	9” Olive Green Floor Tile	9A	WWI-18	Chrysotile 10%
Room 132	Mastic on HA# 9A	9B	WWI-18	Chrysotile 8%
Room 132	9” Olive Green Floor Tile	9A	WWI-19	Positive Stop Analysis
Room 132	Mastic on Ha# 9A	9B	WWI-19	Positive Stop Analysis
Room 134	Red Mastic on Fiberglass Lines/Fittings	10	WWI-20	None Detected
Hallway 105	Red Mastic on Fiberglass Lines/Fittings	10	WWI-21	None Detected
Room 139B	Hard Plaster	11	WWI-22	None Detected
Room 156	Hard Plaster	11	WWI-23	None Detected
Room 151	Hard Plaster	11	WWI-24	None Detected
Hallway 104	Hard Plaster	11	WWI-25	None Detected
Hallway 105	Hard Plaster	11	WWI-26	None Detected
Room 126	Hard Plaster	11	WWI-27	None Detected

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Room 140C	Hard Plaster	11	WWI-28	None Detected
Room 147	12” Blue with Blue Flecks Floor Tile	13A	WWI-29	None Detected
Room 147	Mastic on HA# 13A	13B	WWI-29	Chrysotile 2%
Room 147	Mastic beneath HA# 13A and HA# 13B	13C	WWI-29	Chrysotile 2%
Room 147	Leveling Compound beneath HA# 13C	13D	WWI-29	None Detected
Room 142	12” Blue with Blue Flecks Floor Tile	13A	WWI-30	None Detected
Room 142	Mastic on HA# 13A	13B	WWI-30	Positive Stop Analysis
Room 142	9” Green with White Streaks beneath HA# 13A and HA# 13B	12A	WWI-30	Chrysotile 10%
Room 142	Mastic on HA# 12A	12B	WWI-30	Chrysotile 2%
Room 146A	12” Acoustical Ceiling Tile	14A	WWI-31	None Detected
Room 146A	Mastic on HA# 14A	14B	WWI-31	Chrysotile 2%
Room 146B	12” Acoustical Ceiling Tile	14A	WWI-32	None Detected
Room 146B	Mastic on HA# 14A	14B	WWI-32	Positive Stop Analysis
Hallway 101	Drywall/Joint Compound	15	WWI-33	Drywall- None Detected Joint Comp.- Chrys. 0.25%¥ Composite- Chrys. 0.013%¥
Hallway 201	Drywall/Joint Compound	15	WWI-34	Drywall- None Detected Joint Comp.- Chrys. 0.50%¥ Composite- Chrys. 0.025%¥
Room 140D	12” Light Blue Floor Tile	16A	WWI-35	None Detected
Room 140D	Mastic on HA# 16A	16B	WWI-35	None Detected

¥ verified by point count analysis

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Room 140	12” Light Blue Floor Tile	16A	WWI-36	None Detected
Room 140	Mastic on HA# 16A	16B	WWI-36	None Detected
Room 140	2’x4’ Pinhole Ceiling Tile	17	WWI-37	None Detected
Room 140	2’x4’ Pinhole Ceiling Tile	17	WWI-38	None Detected
Room 140A	Sink Undercoating	18	WWI-39	None Detected
Room 140A	Sink Undercoating	18	WWI-40	None Detected
Hallway 105	12’ Cream with Black Flecks Floor Tile	19A	WWI-41	Chrysotile 2%
Hallway 105	Mastic on HA# 19A	19B	WWI-41	Chrysotile 8%
Hallway 102	12” Cream with Black Flecks Floor Tile	19A	WWI-42	Positive Stop Analysis
Hallway 102	Mastic on HA# 19A	19B	WWI-42	Positive Stop Analysis
Hallway 108	12” Olive Green Floor Tile	20A	WWI-43	Chrysotile 3%
Hallway 108	Mastic on HA# 20A	20B	WWI-43	Chrysotile 5%
Hallway 102	12” Olive Green Floor Tile	20A	WWI-44	Positive Stop Analysis
Hallway 102	Mastic on HA# 20A	20B	WWI-44	Positive Stop Analysis
Hallway 104	2’x4’ Textured Pinhole Ceiling Tile	21	WWI-45	None Detected
Hallway 101	2’x4’ Textured Pinhole Ceiling Tile	21	WWI-46	None Detected

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Room 115	9” Grey with White Flecks Floor Tile	22A	WWI-47	Chrysotile 5%
Room 115	Mastic on HA# 22A	22B	WWI-47	Chrysotile 5%
Room 131	9” Grey with White Flecks Floor Tile	22A	WWI-48	Positive Stop Analysis
Room 131	Mastic on HA# 22A	22B	WWI-48	Positive Stop Analysis
Room 105	12” Cream with Brown Flecks Floor Tile	23A	WWI-49	None Detected
Room 105	Mastic on HA# 23A	23B	WWI-49	None Detected
Room 105	12” Cream with Brown Flecks Floor Tile	23A	WWI-50	None Detected
Room 105	Mastic on HA# 23A	23B	WWI-50	None Detected
Room 114	12” Blue with White Flecks Floor Tile	24A	WWI-51	None Detected
Room 114	Mastic on HA# 24A	24B	WWI-51	None Detected
Room 110A	12” Blue with White Flecks Floor Tile	24A	WWI-52	None Detected
Room 110A	Mastic on HA# 24A	24B	WWI-52	None Detected
Room 110B	9” Cream with White Flecks Floor Tile	25A	WWI-53	Chrysotile 2%
Room 110B	Mastic on HA# 25A	25B	WWI-53	Chrysotile 5%
Room 110B	9” Cream with White Flecks Floor Tile	25A	WWI-54	Positive Stop Analysis
Room 110B	Mastic on HA# 25A	25B	WWI-54	Positive Stop Analysis

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Hallway 110	12” Cream with Black Dots Floor Tile	26A	WWI-55	Chrysotile 5%
Hallway 110	Mastic on HA# 26A	26B	WWI-55	None Detected
Hallway 110	12” Cream with Black Dots Floor Tile	26A	WWI-56	Positive Stop Analysis
Hallway 110	Mastic on HA# 26A	26B	WWI-56	None Detected
Room 218	9” Tan with White Flecks Floor Tile	27A	WWI-57	Chrysotile 10%
Room 218	Mastic on HA# 27A	27B	WWI-57	Chrysotile 8%
Room 219	9” Tan with White Flecks Floor Tile	27A	WWI-58	Positive Stop Analysis
Room 219	Mastic on HA# 27A	27B	WWI-58	Positive Stop Analysis
Hallway 201	12” Green with Black Flecks Floor Tile	28A	WWI-59	Chrysotile 3%
Hallway 201	Mastic on HA# 28A	28B	WWI-59	Chrysotile 8%
Hallway 201	12” Green with Black Flecks Floor Tile	28A	WWI-60	Positive Stop Analysis
Hallway 201	Mastic on HA# 28A	28B	WWI-60	Positive Stop Analysis
Room 111	Bedding on Metal Windows	29	WWI-61	Chrysotile 2%
Room 131	Bedding on Metal Windows	29	WWI-62	Positive Stop Analysis
Exterior of Building	Window Caulking	30	WWI-63	0.22% Chrysotile¥¥
Exterior of Building	Window Caulking	30	WWI-64	0.38% Chrysotile¥¥

¥ ¥ verified by gravimetric point count analysis

4.0 Inventory of Asbestos-Containing Materials

The following table presents a list of asbestos-containing materials identified during the inspection.

Table 4-1: Asbestos-Containing Materials Inventory

Room/Location	Material Type	Condition/ Hazard Rank	Estimated Quantity
Room 129	Cementitious Fitting Insulation	Good/3	39 fittings
Room 122	Cementitious Fitting Insulation	Good/3	8 fittings
Room 123	Cementitious Fitting Insulation	Good/3	3 fittings
Hallway 107	Cementitious Fitting Insulation	Good/3	1 fitting
Room 125/125A	Cementitious Fitting Insulation	Good/3	10 fittings
Cafeteria	Cementitious Fitting Insulation	Good/3	24 fittings
Room 136A	Cementitious Fitting Insulation	Good/3	24 fittings
Room 136D	Cementitious Fitting Insulation	Good/3	61 fittings
Room 137	Cementitious Fitting Insulation	Good/2	96 fittings (assumed)
Room 132	Cementitious Fitting Insulation	Good/3	6 fittings
Room 126	Cementitious Fitting Insulation	Good/3	8 fittings
Room 127	Cementitious Fitting insulation	Good/3	20 fittings
Room 146A	Cementitious Fitting Insulation	Good/3	12 fittings
Room 146C	Cementitious Fitting Insulation	Good/3	6 fittings
Room 146	Cementitious Fitting Insulation	Good/3	12 fittings

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 146B	Cementitious Fitting Insulation	Good/3	8 fittings
Room 144	Cementitious Fitting Insulation	Good/3	1 fitting
Room 143	Cementitious Fitting Insulation	Good/3	7 fittings
Room 142	Cementitious Fitting Insulation	Good/3	16 fittings
Room 140D	Cementitious Fitting Insulation	Good/3	11 fittings
Room 140C	Cementitious Fitting Insulation	Good/3	22 fittings
Room 140B	Cementitious Fitting Insulation	Good/3	1 fitting
Room 139C	Cementitious Fitting Insulation	Good/3	1 fitting
Room 138	Cementitious Fitting Insulation	Good/3	13 fittings
Hallway 103	Cementitious Fitting Insulation	Good/3	3 fittings
Hallway 102	Cementitious Fitting Insulation	Good/3	10 fittings
Hallway 101	Cementitious Fitting Insulation	Good/3	51 fittings
Room 131/131A	Cementitious Fitting Insulation	Good/3	16 fittings
Room 103	Cementitious Fitting Insulation	Good/3	6 fittings
Room 102	Cementitious Fitting Insulation	Good/3	7 fittings
Hallway 109	Cementitious Fitting Insulation	Good/3	16 fittings
Room 101 A/B	Cementitious Fitting Insulation	Good/3	28 fittings

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 104	Cementitious Fitting Insulation	Good/3	9 fittings
Room 105	Cementitious Fitting Insulation	Good/3	9 fittings
Room 107	Cementitious Fitting Insulation	Good/3	9 fittings
Room 108	Cementitious Fitting Insulation	Good/3	8 fittings
Room 151	Cementitious Fitting Insulation	Good/3	9 fittings
Room 153	Cementitious Fitting Insulation	Good/3	9 fittings
Room 152	Cementitious Fitting Insulation	Good/3	11 fittings
Room 106	Cementitious Fitting Insulation	Good/3	10 fittings
Room 109	Cementitious Fitting Insulation	Good/3	9 fittings
Room 110A	Cementitious Fitting Insulation	Good/3	4 fittings
Room 110B	Cementitious Fitting Insulation	Good/3	7 fittings
Room 111	Cementitious Fitting Insulation	Good/3	7 fittings
Room 112	Cementitious Fitting Insulation	Good/3	7 fittings
Hallway 108	Cementitious Fitting Insulation	Good/3	27 fittings
Room 113	Cementitious Fitting Insulation	Good/3	5 fittings
Room 114	Cementitious Fitting Insulation	Good/3	13 fittings
Room 115	Cementitious Fitting Insulation	Good/3	7 fittings

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 116	Cementitious Fitting Insulation	Good/3	7 fittings
Room 117	Cementitious Fitting Insulation	Good/3	7 fittings
Room 118	Cementitious Fitting Insulation	Good/3	7 fittings
Room 119	Cementitious Fitting Insulation	Good/3	9 fittings
Room 121	Cementitious Fitting Insulation	Good/3	6 fittings
Hallway 105	Cementitious Fitting Insulation	Good/3	12 fittings
Room 155	Cementitious Fitting Insulation	Good/3	16 fittings
Room 156	Cementitious Fitting Insulation	Good/3	16 fittings
Room 157	Cementitious Fitting Insulation	Good/3	2 fittings
Hallway 110	Cementitious Fitting Insulation	Good3	21 fittings
Room 214	Cementitious Fitting Insulation	Good/3	7 fittings
Room 213	Cementitious Fitting Insulation	Good/3	7 fittings
Room 212	Cementitious Fitting Insulation	Good/7	7 fittings
Room 218	Cementitious Fitting Insulation	Good/3	7 fittings
Room 222	Cementitious Fitting Insulation	Good/3	11 fittings
Room 214	Cementitious Fitting Insulation	Good/3	7 fittings
Room 215	Cementitious Fitting Insulation	Good/3	7 fittings

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 216	Cementitious Fitting Insulation	Good/3	10 fittings
Room 219	Cementitious Fitting Insulation	Good/3	15 fittings
Room 217	Cementitious Fitting Insulation	Good/2	7 fittings
Room 220	Cementitious Fitting Insulation	Good/3	7 fittings
Room 221	Cementitious Fitting Insulation	Good/3	10 fittings
Hallway 201	Cementitious Fitting Insulation	Good/3	14 fittings
Room 136	9” Grey Floor Tile/Mastic	Non-Friable	3,034 sf.
Room 136C	9” Grey Floor Tile/Mastic	Non-Friable	1,500 sf.
Room 132	9” Olive Green Floor Tile/Mastic	Non-Friable	384 sf.
Room 147	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Flecks Floor Tile/Mastic	Non-Friable	420 sf.
Room 146A	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	121 sf.
Room 146C	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	884 sf.
Room 146	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Streaks Floor Tile/Mastic	Non-Friable	1,440 sf.
Room 146B	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	77 sf.
Room 144	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Streaks Floor Tile/Mastic	Non-Friable	364 sf.
Room 143	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Streaks Floor Tile/Mastic	Non-Friable	414 sf.
Room 142	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Streaks Floor Tile/Mastic	Non-Friable	54 sf.

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Hallway 103	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	315 sf.
Hallway 102	12” Olive Green Floor Tile/Mastic	Non-Friable	900 sf.
Hallway 101	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	900 sf.
Hallway 101	12” Olive Green Floor Tile/Mastic	Non-Friable	1,600 sf.
Room 131/131A	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	1,924 sf.
Room 148	9” Grey Floor Tile/Mastic	Non-Friable	300 sf.
Room 149	9” Grey Floor Tile/Mastic	Non-Friable	70 sf.
Room 150	9” Grey Floor Tile/Mastic	Non-Friable	70 sf.
Room 130	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	338 sf.
Hallway 109	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	330 sf.
Hallway 109	12” Olive Green Floor Tile/Mastic	Non-Friable	330 sf.
Room 104	9” Olive Green Floor Tile/Mastic	Non-Friable	675 sf.
Room 107	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	621 sf.
Room 108	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	690 sf.
Room 106	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	728 sf.
Room 102	9” Grey with White Floor Tile/Mastic	Non-Friable	700 sf.
Room 103	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	783 sf.

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 110B	9” Cream with White Flecks Floor Tile/Mastic	Non-Friable	675 sf.
Room 111	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	728 sf.
Room 112	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	1,134 sf. (beneath carpet)
Hallway 108	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	1,100 sf.
Hallway 108	12” Olive Green Floor Tile/Mastic	Non-Friable	1,100 sf.
Room 113	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	1,196 sf.
Room 114	9” Grey with White Flecks Floor Tile	Non-Friable	1,196 sf. (beneath 12” tile)
Room 115	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	728 sf.
Room 116	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	728 sf.
Room 117	9” Grey Floor Tile/Mastic	Non-Friable	728 sf.
Room 118	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	728 sf.
Room 119	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	728 sf.
Hallway 105	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	1,000 sf
Hallway 105	12” Olive Green Floor Tile/Mastic	Non-Friable	1,000 sf
Room 120	9” Grey Floor Tile/Mastic	Non-Friable	1,040 sf.
Hallway 110	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	400 sf.
Hallway 110	12” Olive Green Floor Tile/Mastic	Non-Friable	400 sf.

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Hallway 110	12” Cream with Black Dots Floor Tile	Non-Friable	80 sf.
Room 214	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 213	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 215	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 212	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 216	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 217	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 218	9” Tan with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 219	9” Tan with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 220	9” Tan with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 221	9” Tan with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 222	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	260 sf.
Hallway 201	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	605 sf.
Hallway 201	12” Green with Black Flecks Floor Tile/Mastic	Non-Friable	605 sf.
Room 137B	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	100 sf.
Room 146A	Mastic on 12” Acoustical Tile	Non-Friable	121 sf.
Room 146	Mastic on 12” Acoustical Tile	Non-Friable	400 sf.

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 146B	Mastic on 12” Acoustical Tile	Non-Friable	50 sf.
Exterior/Interior of Building	Bedding on Metal Windows	Non-Friable	1,944 lf.
Throughout Building	Black Cove Base Mastic	Non-Friable	7,436 lf.
Hallway 142	Vibration Gasket (assumed)	Non-Friable	20 sf.
Room 138	Vibration Gasket (assumed)	Non-Friable	20 sf.
Throughout Building	Chalkboard Mastic (assumed)	Unknown	1,844 sf.
Throughout Building	Roofing Materials (assumed)	Non-Friable	81,200 sf.
Gymnasium	Vapor Barrier (assumed)	Unknown	6,935 sf.

Appendix A

Laboratory Results

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July 22, 2019

Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

CLIENT PROJECT: WW Intermediate, 19-14.15
CEI LAB CODE: A1914163

Dear Customer:

Enclosed are asbestos analysis results for PLM Bulk samples received at our laboratory on July 15, 2019. The samples were analyzed for asbestos using polarizing light microscopy (PLM) per the EPA 600 Method.

Sample results containing >1% asbestos are considered asbestos-containing materials (ACMs) per EPA regulatory requirements. The detection limit for the EPA 600 Method is <1% asbestos by weight as determined by visual estimation.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Mac Paran Consulting Services, Inc.

CLIENT PROJECT: WW Intermediate, 19-14.15

LAB CODE: A1914163

TEST METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 07/22/19

TOTAL SAMPLES ANALYZED: 52

SAMPLES >1% ASBESTOS: 25

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: WW Intermediate, 19-14.15 **LAB CODE:** A1914163

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
WWI-1		A192790	Gray	Hard Fitting	Chrysotile 10%
WWI-2		A192791		Sample Not Analyzed per COC	
WWI-3		A192792		Sample Not Analyzed per COC	
WWI-4		A192793	Red	Rope Gasket	None Detected
WWI-5		A192794	Red	Rope Gasket	None Detected
WWI-6		A192795	Gray	Roof Drain	Chrysotile <1%
WWI-7		A192796	Gray	Roof Drain	Chrysotile <1%
WWI-8		A192797A	Gray,Blue	Floor Tile	None Detected
		A192797B	Yellow	Mastic	None Detected
WWI-9		A192798A	Gray,Blue	Floor Tile	None Detected
		A192798B	Yellow	Mastic	None Detected
WWI-10		A192799	White	Fissured Ct	None Detected
WWI-11		A192800	White	Fissured Ct	None Detected
WWI-12		A192801	Brown	Cove Base Mastic	Chrysotile 2%
WWI-13		A192802		Sample Not Analyzed per COC	
WWI-14		A192803	Gray	Drywall	None Detected
WWI-15		A192804	Gray	Drywall	None Detected
WWI-16		A192805A	Gray	Floor Tile	Chrysotile 10%
		A192805B	Black	Mastic	Chrysotile 5%
WWI-17		A192806A		Sample Not Analyzed per COC	
		A192806B		Sample Not Analyzed per COC	
WWI-18		A192807A	Olive Green	Floor Tile	Chrysotile 10%
		A192807B	Black	Mastic	Chrysotile 8%
WWI-19		A192808A		Sample Not Analyzed per COC	
		A192808B		Sample Not Analyzed per COC	
WWI-20		A192809	Red	Mastic	None Detected
WWI-21		A192810	Red	Mastic	None Detected
WWI-22	Layer 1	A192811	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192811	Gray	Hard Plaster Base Coat	None Detected
WWI-23	Layer 1	A192812	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192812	Gray	Hard Plaster Base Coat	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: WW Intermediate, 19-14.15 **LAB CODE:** A1914163

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
WWI-24	Layer 1	A192813	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192813	Gray	Hard Plaster Base Coat	None Detected
WWI-25	Layer 1	A192814	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192814	Gray	Hard Plaster Base Coat	None Detected
WWI-26	Layer 1	A192815	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192815	Gray	Hard Plaster Base Coat	None Detected
WWI-27	Layer 1	A192816	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192816	Gray	Hard Plaster Base Coat	None Detected
WWI-28	Layer 1	A192817	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192817	Gray	Hard Plaster Base Coat	None Detected
WWI-29		A192818A	Blue	Floor Tile	None Detected
	Layer 1	A192818B	Black	Mastic	Chrysotile 2%
	Layer 2	A192818B	Brown	Mastic	Chrysotile 2%
	Layer 3	A192818B	Gray	Leveling Compound	None Detected
WWI-30		A192819A	Blue	Floor Tile	None Detected
		A192819B		Sample Not Analyzed per COC	
		A192819C	Green	Floor Tile	Chrysotile 10%
		A192819D	Black	Mastic	Chrysotile 2%
WWI-31		A192820A	White	Ceiling Tile	None Detected
		A192820B	Brown	Mastic	Chrysotile 2%
WWI-32		A192821A	White	Ceiling Tile	None Detected
		A192821B		Sample Not Analyzed per COC	
WWI-33		A192822	Gray	Drywall/Joint Compound	Chrysotile <1%
WWI-34		A192823	Gray	Drywall/Joint Compound	Chrysotile <1%
WWI-35		A192824A	Blue	Floor Tile	None Detected
		A192824B	Yellow	Mastic	None Detected
WWI-36		A192825A	Blue	Floor Tile	None Detected
		A192825B	Yellow	Mastic	None Detected
WWI-37		A192826	White	Pinhole Ct	None Detected
WWI-38		A192827	White	Pinhole Ct	None Detected
WWI-39		A192828	White	Sink Undercoating	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: WW Intermediate, 19-14.15 **LAB CODE:** A1914163

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
WWI-40		A192829	White	Sink Undercoating	None Detected
WWI-41		A192830A	Cream	Floor TIle	Chrysotile 2%
		A192830B	Black	Mastic	Chrysotile 8%
WWI-42		A192831A		Sample Not Analyzed per COC	
		A192831B		Sample Not Analyzed per COC	
WWI-43		A192832A	Olive	Floor TIle	Chrysotile 3%
		A192832B	Black	Mastic	Chrysotile 5%
WWI-44		A192833A		Sample Not Analyzed per COC	
		A192833B		Sample Not Analyzed per COC	
WWI-45		A192834	White	Textured Pinhole Ct	None Detected
WWI-46		A192835	White	Textured Pinhole Ct	None Detected
WWI-47		A192836A	Gray	Floor TIle	Chrysotile 5%
		A192836B	Black	Mastic	Chrysotile 5%
WWI-48		A192837A		Sample Not Analyzed per COC	
		A192837B		Sample Not Analyzed per COC	
WWI-49		A192838A	Cream	Floor TIle	None Detected
		A192838B	Yellow	Mastic	None Detected
WWI-50		A192839A	Cream	Floor TIle	None Detected
		A192839B	Yellow	Mastic	None Detected
WWI-51		A192840A	Blue,White	Floor Tile	None Detected
		A192840B	Yellow	Mastic	None Detected
WWI-52		A192841A	Blue,White	Floor Tile	None Detected
		A192841B	Yellow	Mastic	None Detected
WWI-53		A192842A	Cream	Floor Tile	Chrysotile 2%
		A192842B	Black	Mastic	Chrysotile 5%
WWI-54		A192843A		Sample Not Analyzed per COC	
		A192843B		Sample Not Analyzed per COC	
WWI-55		A192844A	Cream	Floor Tile	Chrysotile 5%
		A192844B	Yellow	Mastic	None Detected
WWI-56		A192845A		Sample Not Analyzed per COC	
		A192845B	Yellow	Mastic	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: WW Intermediate, 19-14.15 **LAB CODE:** A1914163

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
WWI-57		A192846A	Tan,White	Floor Tile	Chrysotile 10%
		A192846B	Black,White	Mastic	Chrysotile 8%
WWI-58		A192847A		Sample Not Analyzed per COC	
		A192847B		Sample Not Analyzed per COC	
WWI-59		A192848A	Green	Floor Tile	Chrysotile 3%
		A192848B	Black	Mastic	Chrysotile 8%
WWI-60		A192849A		Sample Not Analyzed per COC	
		A192849B		Sample Not Analyzed per COC	
WWI-61		A192850	Gray	Window Bedding	Chrysotile 2%
WWI-62		A192851		Sample Not Analyzed per COC	
WWI-63		A192852	White	Window Caulking	Chrysotile <1%
WWI-64		A192853	Black	Window Caulking	Chrysotile <1%

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-1 A192790	Hard Fitting	Homogeneous Gray Fibrous Bound	60% 10%	Mineral Wool Fiberglass	20%	Calc Carb	10% Chrysotile
WWI-2 A192791	Sample Not Analyzed per COC						
WWI-3 A192792	Sample Not Analyzed per COC						
WWI-4 A192793	Rope Gasket	Heterogeneous Red Fibrous Bound	80%	Fiberglass	20%	Caulk	None Detected
WWI-5 A192794	Rope Gasket	Heterogeneous Red Fibrous Bound	80%	Fiberglass	20%	Caulk	None Detected
WWI-6 A192795	Roof Drain	Homogeneous Gray Fibrous Bound	60% 20%	Mineral Wool Fiberglass	20%	Calc Carb	<1% Chrysotile
WWI-7 A192796	Roof Drain	Homogeneous Gray Fibrous Bound	60% 20%	Mineral Wool Fiberglass	20%	Calc Carb	<1% Chrysotile
WWI-8 A192797A	Floor Tile	Homogeneous Gray,Blue Non-fibrous Bound			100%	Vinyl	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
A192797B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
WWI-9 A192798A	Floor Tile	Homogeneous Gray,Blue Non-fibrous Bound			100%	Vinyl	None Detected
A192798B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
WWI-10 A192799	Fissured Ct	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
WWI-11 A192800	Fissured Ct	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
WWI-12 A192801	Cove Base Mastic	Homogeneous Brown Non-fibrous Bound			98%	Mastic	**2% Chrysotile**
WWI-13 A192802	Sample Not Analyzed per COC						
WWI-14 A192803	Drywall	Heterogeneous Gray Fibrous Bound	15% 5%	Cellulose Fiberglass	80% <1%	Gypsum Vermiculite	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-15 A192804	Drywall	Heterogeneous Gray Fibrous Bound	15% 5%	Cellulose Fiberglass	80% <1%	Gypsum Vermiculite	None Detected
WWI-16 A192805A	Floor Tile	Homogeneous Gray Non-fibrous Bound			90%	Vinyl	**10% Chrysotile**
A192805B	Mastic	Homogeneous Black Non-fibrous Bound			95%	Mastic	**5% Chrysotile**
WWI-17 A192806A	Sample Not Analyzed per COC						
A192806B	Sample Not Analyzed per COC						
WWI-18 A192807A	Floor Tile	Homogeneous Olive Green Non-fibrous Bound			90%	Vinyl	**10% Chrysotile**
A192807B	Mastic	Homogeneous Black Non-fibrous Bound			92%	Mastic	**8% Chrysotile**
WWI-19 A192808A	Sample Not Analyzed per COC						
A192808B	Sample Not Analyzed per COC						

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-20 A192809	Mastic	Homogeneous Red Fibrous Bound	10%	Cellulose	90%	Mastic	None Detected
WWI-21 A192810	Mastic	Homogeneous Red Fibrous Bound	10%	Cellulose	90%	Mastic	None Detected
WWI-22 Layer 1 A192811	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
Layer 2 A192811	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
WWI-23 Layer 1 A192812	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
Layer 2 A192812	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
WWI-24 Layer 1 A192813	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound			75% 25%	Silicates Binder	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	 Non-Fibrous	ASBESTOS %
Layer 2 A192813	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
WWI-25 Layer 1 A192814	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
Layer 2 A192814	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
WWI-26 Layer 1 A192815	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
Layer 2 A192815	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
WWI-27 Layer 1 A192816	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
Layer 2 A192816	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound	75% 25%	Silicates Binder	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
WWI-28	Hard Plaster Skim Coat	Heterogeneous		75%	Silicates	None Detected
Layer 1		White		25%	Binder	
A192817		Non-fibrous				
		Bound				
Layer 2	Hard Plaster Base Coat	Heterogeneous		75%	Silicates	None Detected
A192817		Gray		25%	Binder	
		Non-fibrous				
		Bound				
WWI-29	Floor Tile	Homogeneous		100%	Vinyl	None Detected
A192818A		Blue				
		Non-fibrous				
		Bound				
Layer 1	Mastic	Homogeneous		98%	Mastic	2% Chrysotile
A192818B		Black				
		Non-fibrous				
		Bound				
Layer 2	Mastic	Homogeneous		98%	Mastic	2% Chrysotile
A192818B		Brown				
		Non-fibrous				
		Bound				
Layer 3	Leveling Compound	Homogeneous		100%	Binder	None Detected
A192818B		Gray				
		Non-fibrous				
		Bound				
WWI-30	Floor Tile	Homogeneous		100%	Vinyl	None Detected
A192819A		Blue				
		Non-fibrous				
		Bound				
A192819B	Sample Not Analyzed per COC					

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
A192819C	Floor Tile	Homogeneous Green Non-fibrous Bound			90%	Vinyl	10% Chrysotile
A192819D	Mastic	Homogeneous Black Non-fibrous Bound			98%	Mastic	2% Chrysotile
WWI-31 A192820A	Ceiling Tile	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
A192820B	Mastic	Homogeneous Brown Fibrous Bound			98%	Mastic	2% Chrysotile
WWI-32 A192821A	Ceiling Tile	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
A192821B	Sample Not Analyzed per COC						
WWI-33 A192822	Drywall/Joint Compound	Heterogeneous Gray Fibrous Bound	15% 5%	Cellulose Fiberglass	65% 10% 5%	Gypsum Calc Carb Paint	<1% Chrysotile

Lab Notes: Joint compound contains <1% chrysotile. Overall sample contains <1% chrysotile.

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-34 A192823	Drywall/Joint Compound	Heterogeneous Gray Fibrous Bound	15% 5%	Cellulose Fiberglass	65% 10% 5%	Gypsum Calc Carb Paint	<1% Chrysotile
Lab Notes: Joint compound contains <1% chrysotile. Overall sample contains <1% chrysotile.							
WWI-35 A192824A	Floor Tile	Homogeneous Blue Non-fibrous Bound			100%	Vinyl	None Detected
A192824B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
WWI-36 A192825A	Floor Tile	Homogeneous Blue Non-fibrous Bound			100%	Vinyl	None Detected
A192825B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
WWI-37 A192826	Pinhole Ct	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
WWI-38 A192827	Pinhole Ct	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-39 A192828	Sink Undercoating	Homogeneous White Non-fibrous Bound	60%	Cellulose	40%	Binder	None Detected
WWI-40 A192829	Sink Undercoating	Homogeneous White Non-fibrous Bound	60%	Cellulose	40%	Binder	None Detected
WWI-41 A192830A	Floor TIle	Homogeneous Cream Non-fibrous Bound			98%	Vinyl	**2% Chrysotile**
A192830B	Mastic	Homogeneous Black Non-fibrous Bound			92%	Mastic	**8% Chrysotile**
WWI-42 A192831A	Sample Not Analyzed per COC						
A192831B	Sample Not Analyzed per COC						
WWI-43 A192832A	Floor TIle	Homogeneous Olive Non-fibrous Bound			97%	Vinyl	**3% Chrysotile**
A192832B	Mastic	Homogeneous Black Non-fibrous Bound			95%	Mastic	**5% Chrysotile**
WWI-44 A192833A	Sample Not Analyzed per COC						

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
A192833B	Sample Not Analyzed per COC						
WWI-45 A192834	Textured Pinhole Ct	Heterogeneous White Fibrous Bound	60% 30%	Cellulose Fiberglass	5% 5%	Perlite Paint	None Detected
WWI-46 A192835	Textured Pinhole Ct	Heterogeneous White Fibrous Bound	60% 30%	Cellulose Fiberglass	5% 5%	Perlite Paint	None Detected
WWI-47 A192836A	Floor TIle	Homogeneous Gray Non-fibrous Bound			95%	Vinyl	**5% Chrysotile**
A192836B	Mastic	Homogeneous Black Non-fibrous Bound			95%	Mastic	**5% Chrysotile**
WWI-48 A192837A	Sample Not Analyzed per COC						
A192837B	Sample Not Analyzed per COC						
WWI-49 A192838A	Floor TIle	Homogeneous Cream Non-fibrous Bound			100%	Vinyl	None Detected
A192838B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
WWI-50 A192839A	Floor TIle	Homogeneous Cream Non-fibrous Bound		100%	Vinyl	None Detected
A192839B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
WWI-51 A192840A	Floor Tile	Homogeneous Blue,White Non-fibrous Bound		100%	Vinyl	None Detected
A192840B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
WWI-52 A192841A	Floor Tile	Homogeneous Blue,White Non-fibrous Bound		100%	Vinyl	None Detected
A192841B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
WWI-53 A192842A	Floor Tile	Homogeneous Cream Non-fibrous Bound		98%	Vinyl	**2% Chrysotile**

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	 Non-Fibrous	ASBESTOS %
A192842B	Mastic	Homogeneous Black Non-fibrous Bound	95%	Mastic	**5% Chrysotile**
WWI-54 A192843A	Sample Not Analyzed per COC				
A192843B	Sample Not Analyzed per COC				
WWI-55 A192844A	Floor Tile	Homogeneous Cream Non-fibrous Bound	95%	Vinyl	**5% Chrysotile**
A192844B	Mastic	Homogeneous Yellow Non-fibrous Bound	100%	Mastic	None Detected
WWI-56 A192845A	Sample Not Analyzed per COC				
A192845B	Mastic	Homogeneous Yellow Non-fibrous Bound	100%	Mastic	None Detected
WWI-57 A192846A	Floor Tile	Homogeneous Tan,White Non-fibrous Bound	90%	Vinyl	**10% Chrysotile**
A192846B	Mastic	Homogeneous Black,White Non-fibrous Bound	92%	Mastic	**8% Chrysotile**

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
WWI-58 A192847A	Sample Not Analyzed per COC					
A192847B	Sample Not Analyzed per COC					
WWI-59 A192848A	Floor Tile	Homogeneous Green Non-fibrous Bound		97%	Vinyl	3% Chrysotile
A192848B	Mastic	Homogeneous Black Non-fibrous Bound		92%	Mastic	8% Chrysotile
WWI-60 A192849A	Sample Not Analyzed per COC					
A192849B	Sample Not Analyzed per COC					
WWI-61 A192850	Window Bedding	Homogeneous Gray Fibrous Bound		88% 10%	Binder Calc Carb	2% Chrysotile
WWI-62 A192851	Sample Not Analyzed per COC					
WWI-63 A192852	Window Caulking	Homogeneous White Non-fibrous Bound		100%	Caulk	<1% Chrysotile
WWI-64 A192853	Window Caulking	Homogeneous Black Non-fibrous Bound		100%	Caulk	<1% Chrysotile

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LEGEND: Non-Anth = Non-Asbestiform Anthophyllite
Non-Trem = Non-Asbestiform Tremolite
Calc Carb = Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REPORTING LIMIT FOR POINT COUNTS: 0.25% by 400 Points or 0.1% by 1,000 Points

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. *Estimated measurement of uncertainty is available on request.*

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: Ryan Steele

Ryan Steele

APPROVED BY:

Tianbao Bai, Ph.D., CIH
Laboratory Director

Megan Fisher

NVLAP TESTING
NVLAP LAB CODE 101768-0

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July 31, 2019

Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

CLIENT PROJECT: WW Intermediate, 19-14.15 (400 Point Count)
CEI LAB CODE: A1914163A

Dear Customer:

Enclosed are asbestos analysis results for PLM bulk samples received at our laboratory on July 25, 2019. The samples were analyzed for asbestos using polarized light microscopy (PLM) point count per the EPA 600 Method.

Sample results containing > 1% asbestos are considered asbestos-containing materials (ACMs) per the EPA regulatory requirements. The detection limit for the EPA 600 method is 0.25% for 400 point counts, or 0.1% for 1,000 point counts.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Mac Paran Consulting Services, Inc.

CLIENT PROJECT: WW Intermediate, 19-14.15 (400 Point Count)

LAB CODE: A1914163A

TEST METHOD: PLM Point Count
EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 07/31/19

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

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Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163A
Date Received: 07-25-19
Date Analyzed: 07-30-19
Date Reported: 07-31-19

Project: WW Intermediate, 19-14.15 (400 Point Count)

ASBESTOS POINT COUNT PLM, EPA 600 METHOD

Client ID	Lab ID	Material Description	POINTS Total	POINTS Asbestos	ASBESTOS %	
WWI-6	A192795	Roof Drain	400	0	**<0.25%**	**Chrysotile**
Lab Notes: Chrysotile detected below limit of quantitation.						
WWI-7	A192796	Roof Drain	400	0	**<0.25%**	**Chrysotile**
Lab Notes: Chrysotile detected below limit of quantitation.						

LEGEND: None

METHOD: EPA 600 / M4 / 82 / 020 (40 CFR Part 763, Sub. E, App. E)

REPORTING LIMIT: 0.25% by 400 points or 0.1% by 1,000 points

REGULATORY LIMIT: >1% by weight

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. *Estimated measurement of uncertainty is available on request.* This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: Ryan Steele

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Megan Fisher

NVLAP TESTING
NVLAP LAB CODE 101768-0

August 22, 2019

Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

CLIENT PROJECT: WW Intermediate, 19-14.15 (400 Point Count)
CEI LAB CODE: A1914163C

Dear Customer:

Enclosed are asbestos analysis results for PLM bulk samples received at our laboratory on August 20, 2019. The samples were analyzed for asbestos using polarized light microscopy (PLM) point count per the EPA 600 Method.

Sample results containing > 1% asbestos are considered asbestos-containing materials (ACMs) per the EPA regulatory requirements. The detection limit for the EPA 600 method is 0.25% for 400 point counts, or 0.1% for 1,000 point counts.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Mac Paran Consulting Services, Inc.

CLIENT PROJECT: WW Intermediate, 19-14.15 (400 Point Count)

LAB CODE: A1914163C

TEST METHOD: PLM Point Count
EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 08/22/19

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

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Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163C
Date Received: 08-20-19
Date Analyzed: 08-21-19
Date Reported: 08-22-19

Project: WW Intermediate, 19-14.15 (400 Point Count)

ASBESTOS POINT COUNT PLM, EPA 600 METHOD

Client ID	Lab ID	Material Description	POINTS Total	POINTS Asbestos	ASBESTOS %	
WWI-33	A192822	Joint Compound (Point Count)	400	1	**0.25%**	**Chrysotile**
	A192822	Drywall/joint Compound (Composite Result From Point Count)	400		**0.013**	**Chrysotile**
Lab Notes: Joint compound is 5% of overall sample.						
WWI-34	A192823	Joint Compound (Point Count)	400	2	**0.50%**	**Chrysotile**
	A192823	Drywall/joint Compound (Composite Result From Point Count)	400		**0.025**	**Chrysotile**
Lab Notes: Joint compound is 5% of overall sample.						

LEGEND: None

METHOD: EPA 600 / M4 / 82 / 020 (40 CFR Part 763, Sub. E, App. E)

REPORTING LIMIT: 0.25% by 400 points or 0.1% by 1,000 points

REGULATORY LIMIT: >1% by weight

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. *Estimated measurement of uncertainty is available on request.* This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: Ryan Steele

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Megan Fisher

NVLAP TESTING
NVLAP LAB CODE 101768-0

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July 31, 2019

Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

CLIENT PROJECT: WW Intermediate, 19-14.15 (Gravimetric Point Count)
CEI LAB CODE: A1914163B

Dear Customer:

Enclosed are asbestos analysis results for PLM bulk samples received at our laboratory on July 25, 2019. The samples were analyzed for asbestos using polarized light microscopy (PLM) gravimetric point count per the EPA 600 Method.

Sample results containing > 1% asbestos are considered asbestos-containing materials (ACMs) per the EPA regulatory requirements. The detection limit for the EPA 600 method is < 0.25% for gravimetric point count depending on the processed sample weight and points counted.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Mac Paran Consulting Services, Inc.

CLIENT PROJECT: WW Intermediate, 19-14.15 (Gravimetric Point Count)

LAB CODE: A1914163B

TEST METHOD: PLM Gravimetric Point Count
EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 07/31/19

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163B
Date Received: 07-25-19
Date Analyzed: 07-30-19
Date Reported: 07-31-19

Project: WW Intermediate, 19-14.15 (Gravimetric Point Count)

ASBESTOS GRAVIMETRIC POINT COUNT PLM, EPA 600 METHOD

Client ID Lab ID	Material Description	Sample Weight (g)	Organic Material (%)	Acid Soluble Material (%)	Acid Insoluble Material (%)	ASBESTOS %	
WWI-63 A192852	Window Caulking (Gravimetric Point Count)	0.129	41	37	22	**0.22%**	**Chrysotile**
WWI-64 A192853	Window Caulking (Gravimetric Point Count)	0.18	41	34	25	**0.38%**	**Chrysotile**

LEGEND: None

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: Varies with the weight and constituents of the sample (<0.25%)

REGULATORY LIMIT: >1% by weight

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. *Estimated measurement of uncertainty is available on request.* This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: Ryan Steele

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Megan Fisher

NVLAP TESTING
NVLAP LAB CODE 101768-0

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730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

CHAIN OF CUSTODY

64

LAB USE ONLY:
CEI Lab Code: A19141163
CEI Lab I.D. Range: A192790 - A192853

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact: Paul Cordy
Company: mac Paran	Email / Tel: Paul@macparan.com
Address: 3959 Fulton Grove RD	Project Name: WW Intermediate
Cincinnati, OH 45245	Project ID#: 19.14-15
Email: Paul@macparan.com	PO #:
Tel: 5137529111 Fax:	STATE SAMPLES COLLECTED IN:

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	1 DAY	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☐	☑
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600		☐	☐	☐	☐	☐
PLM BULK	CARB 435		☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR (PCME)	ISO 10312	☐	☐	☐	☐	☐	☐
TEM AIR	ASTM 6281-15	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD		☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05 (2010)	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09 (2014)	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-16			☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD			☐	☐	☐	☐
TEM QUALITTATIVE	IN-HOUSE METHOD		☐	☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:
POSITIVE STOP ANALYSIS

☒ Accept Samples
☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	7/12/19 1:03	[signature]	7/15 9:20

Samples will be disposed of 30 days after analysis

A1914163

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: Mac Paran	Job Contact: Paul Cordy
Project Name: WWI Intermediate	Paul@macparan.com
Project ID #: 19-14.15	Tel: 513-752-9111

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
WWI - 1	HARD Fitting Room 101	1	PLM ☐	TEM ☐
2	↓ ↓ Room 135D	1	PLM ☐	TEM ☐
3	↓ ↓ Room 129	1	PLM ☐	TEM ☐
4	Rope Gasket Room 129	2	PLM ☐	TEM ☐
5	↓ ↓ Room 129	2	PLM ☐	TEM ☐
6	Roof Drain Room 134	3	PLM ☐	TEM ☐
7	↓ ↓	3	PLM ☐	TEM ☐
8	12" Grey w/ blue FT/M	4	PLM ☐	TEM ☐
9	↓ ↓ ↓	4	PLM ☐	TEM ☐
10	2x4 FISSURED CT Room 139	5	PLM ☐	TEM ☐
11	↓ ↓ ↓ Room 142	5	PLM ☐	TEM ☐
12	Cove Base Mastic H108	6	PLM ☐	TEM ☐
13	↓ ↓ ↓ Room 106	6	PLM ☐	TEM ☐
14	Drywall	7	PLM ☐	TEM ☐
15	↓ ↓	7	PLM ☐	TEM ☐
16	9" Grey FT/M STAGE	8	PLM ☐	TEM ☐
17	↓ ↓	8	PLM ☐	TEM ☐
18	9" Olive Green FT/M Room 132	9	PLM ☐	TEM ☐
19	↓ ↓ ↓	9	PLM ☐	TEM ☐
20	RED MASTIC Room 134	10	PLM ☐	TEM ☐
21	↓ ↓ H105	10	PLM ☐	TEM ☐
22	HARD PLASTER Room 139B	11	PLM ☐	TEM ☐
23	↓ ↓ R-156	11	PLM ☐	TEM ☐
24	↓ ↓ R-151	11	PLM ☐	TEM ☐
25	↓ ↓ H104	11	PLM ☐	TEM ☐
26	↓ ↓ H105	11	PLM ☐	TEM ☐
27	↓ ↓ R-126	11	PLM ☐	TEM ☐
28	↓ ↓ R-140C	11	PLM ☐	TEM ☐

A1914163

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: mac Paran	Job Contact: Paul Cordis
Project Name: WWI INTERMEDIATE	
Project ID #: 19-14.15	Tel: 513-752-9111

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
WWI-29	9"Green FT/12"Blue R-147	12/13	PLM ☐	TEM ☐
30	↓ ↓ R-142	12/13	PLM ☐	TEM ☐
31	12" CT w/MASTIC R-146A	14	PLM ☐	TEM ☐
32	↓ ↓ ↓ R146B	14	PLM ☐	TEM ☐
33	Drywall/Joint Compound H101	15	PLM ☐	TEM ☐
34	↓ ↓ ↓ H201	15	PLM ☐	TEM ☐
35	12" FT/M R-140D	16	PLM ☐	TEM ☐
36	↓ ↓ ↓ R-140	16	PLM ☐	TEM ☐
37	Pinhole CT R-140	17	PLM ☐	TEM ☐
38	↓ ↓ R-140	17	PLM ☐	TEM ☐
39	Sink Undercoating R-140A	18	PLM ☐	TEM ☐
40	↓ ↓	18	PLM ☐	TEM ☐
41	12" Cream w/ black FT H105	19	PLM ☐	TEM ☐
42	↓ ↓ ↓ H102	19	PLM ☐	TEM ☐
43	12" Olive FT/M H108	20	PLM ☐	TEM ☐
44	↓ ↓ ↓ H102	20	PLM ☐	TEM ☐
45	Textured Pinhole CT H104	21	PLM ☐	TEM ☐
46	↓ ↓ H101	21	PLM ☐	TEM ☐
47	9"Grey w/ white FT/M R-115	22	PLM ☐	TEM ☐
48	↓ ↓ ↓ ↓ R-131	22	PLM ☐	TEM ☐
49	12"Cream w/ Brown FT R-105	23	PLM ☐	TEM ☐
50	↓ ↓ ↓ ↓ ↓	23	PLM ☐	TEM ☐
51	12" Blue w/ White FT/M R-114	24	PLM ☐	TEM ☐
52	↓ ↓ ↓ ↓ R-110A	24	PLM ☐	TEM ☐
53	9" CREAM w/ WHITE FT/M	25	PLM ☐	TEM ☐
54	↓ ↓ ↓ R-110B	25	PLM ☐	TEM ☐
55	12"Cream w/ Black FT/M H110	26	PLM ☐	TEM ☐
56	↓ ↓ ↓ ↓ ↓	26	PLM ☐	TEM ☐

A1914163

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: mac Paran	Job Contact: Paul Cordy
Project Name: WW Intermediate	
Project ID #: 19-14.15	Tel: 513 752 9111

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
WWI - 57	9" Tan w/ White FTM R-28	27	PLM ☐	TEM ☐
58	↓ ↓ ↓ ↓ R-29	27	PLM ☐	TEM ☐
59	12" Green w/ black FTM H201	28	PLM ☐	TEM ☐
60	↓ ↓ ↓ ↓ H201	28	PLM ☐	TEM ☐
61	WINDOW BEDDING R-111	29	PLM ☐	TEM ☐
62	↓ ↓ R-131	29	PLM ☐	TEM ☐
63	WINDOW CAULKING		PLM ☐	TEM ☐
64	↓ ↓		PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
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			PLM ☐	TEM ☐

Appendix B

Asbestos Hazard Evaluation Specialist License

Ohio Environmental Protection Agency

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

November 26, 2018

Paul A Cordy
MAC Paran Consulting
3959 Fulton Grove Rd
Cincinnati OH 45245

RE: Asbestos Hazard Evaluation Specialist
Certification Number: ES34509
Expiration Date: 11/14/2019

Dear Paul A Cordy:

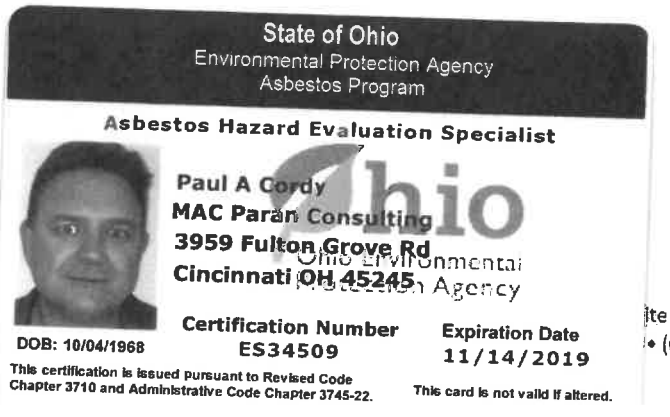
This letter and enclosed certification card approves your request to be certified as an Asbestos Hazard Evaluation Specialist. You must present your card upon request at any project site while performing duties. Copies of cards are not acceptable as proof of certification.

This certification may be revoked by the Director of the Environmental Protection Agency for violation of any of the requirements of 3745-22 or 3745-20 of the Ohio Administrative Code.

If you have any questions, please call 614-644-0226.

Sincerely,

Mark Needham
Manager, Asbestos Program
Division of Air Pollution Control


State of Ohio
Environmental Protection Agency
Asbestos Program

Asbestos Hazard Evaluation Specialist

Paul A Cordy
MAC Paran Consulting
3959 Fulton Grove Rd
Cincinnati OH 45245

DOB: 10/04/1968

Certification Number
ES34509

Expiration Date
11/14/2019

This certification is issued pursuant to Revised Code Chapter 3710 and Administrative Code Chapter 3745-22.

This card is not valid if altered.

ite 700 • P.O. Box 1049 • Columbus, OH 43216-1049
• (614) 644-3020 • (614) 644-3184 (fax)

Appendix C

Universal/Hazardous Waste Materials Inventory

Winton Woods Intermediate School
Universal/Hazardous Waste Inventory

Item	Quantity
4’ Fluorescent Bulbs	2,690
8’ Fluorescent Bulbs	8
Fluorescent Ballasts	672
Compact Fluorescent Lamp Bulbs	86
U Shaped Bulbs	14
Water Fountains with Chlorofluorocarbons	7
Exit Sign Batteries	24
Window Mounted Air-Conditioning Units	34
Roof Air-Conditioning Units	6

NOTE: The information provided is for reference purposes only. The Contractor is responsible for the actual inventory of materials to be removed.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Project information.
2. Work covered by Contract Documents.
3. Completion times and milestone dates.
4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Contractor background check.
8. Specification and Drawing conventions.

B. Related Requirements:
1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Early Childhood ESSER.
1. Project Location: 825 Waycross Road, Cincinnati, Ohio 45240.

B. Owner: Winton Woods City Schools
1. Owner Location: 825 Waycross Road, Suite A, Cincinnati, Ohio 45240.
2. Telephone: 513-619-2300
3. Website: www.wintonwoods.org

C. Architect: SHP.
1. Architect’s Location: 312 Plum Street, Suite 700, Cincinnati, Ohio 45202.
2. Architect’s Construction Representative: Allison McKenzie.
3. Telephone: 513-381-2112.
4. Website: www.shp.com

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:
1. Work includes *HVAC replacement, electrical upgrades, building envelope improvements* and other Work indicated in the Contract Documents.

B. Type of Contract.
1. Project will be constructed under a single prime contract.

1.4 HAZARDOUS MATERIALS AND ABATEMENT SCOPE

A. Hazardous Materials are present in this building. A hazardous materials report has been included in the Project Manual. A previous project abated most of the asbestos containing floor tile and mastic, the black cove base mastic, the mastic on 12” ACT, and the chalkboard adhesive. The Gymnasium floor vapor barrier and Roofing Material will be left in place.

B. The Contractor for this Project shall include the following abatement scope which is indicated in the Hazardous Materials Survey in their Base Bid:
1. Cementitious Fitting Insulation – Approximately 926 asbestos-containing cementitious fittings
2. Window Bedding – For all windows that are being replaced
3. Vibration Gasket – Approximately 40 square feet of asbestos -containing vibration gasket.
4. Universal Waste associated with replaced HVAC units

C. The Contractor for this Project shall include an Allowance of $10,000, as indicated on the Bid Form, for abatement of any remaining asbestos containing flooring and mastic that may be discovered under or around items to be demolished in this Project.

1.5 COMPLETION TIMES AND MILESTONE DATES

A. The following dates have been established for the Project. Contractors shall meet all dates, except for adjustments and extensions of time granted by the Owner under the provisions of the Contract Conditions. All Contractor dates are predicated on Notice to Proceed being issued by the Owner on or before July 1, 2016; if Notice to Proceed is issued later than this date, all subsequent dates shall be adjusted by negotiation with all contracts.

Start of Work at Project Site ..... July 5, 2016
Substantial Completion..... November 18, 2022
Final Completion..... December 18, 2022 Retain "Subsequent Work" Paragraph below if work under future contracts depends on successful completion of work performed under this Contract. Revise to suit Project. See Evaluations for model text.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

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

B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Driveways, Walkways, and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Owner will also occupy the following rooms within the building: 135 Clinic, 136 Book Room, 137 File Storage, 137B Storage, 138 Workroom, 138A Clinic, 138B Psyc Office, 138C RR, 139 Vault, 140 General Office, 141 Guidance, 142 Guidance, 143 Principal, 144 Waiting, 178 Dry Storage, 180 Ref, 181 Freezer, 183 Locker, 185 Dishwashing, 186 Laundry, 187 Office, 188 Kitchen, 188B freezer, 189 Janitor & Stor. Any work in the indicated rooms will need to occur after business hours or on weekends. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.8 COORDINATION WITH OTHER CONTRACTORS

A. The Owner will be bidding out and hiring a Contractor to perform an interior renovation scope of work on this building in the coming months. It is possible that the Interior Renovation Contractor will begin work in the building before this Project achieves Substantial Completion. In so, this Contractor will need to cooperation with the Interior Renovation Contractor to avoid interference.

1.9 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Work shall be generally performed during normal daylight working hours Monday through Friday. Saturday work is permitted if Contractor determines this necessary to attain the indicated schedule and shall be considered part of the Work without claim for extra compensation. Sunday and Holiday work may be permitted with advance request and approval.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated.
1. Notify Owner not less than two days in advance of proposed utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than two days in advance of proposed disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.10 CONTRACTOR BACKGROUND CHECK

A. All contractors working on-site will be subjected to background checks.
1. Contractor shall perform or cause to be performed an Ohio Bureau of Criminal Investigation and Identification criminal background check of the employees of the Contractor or of any subcontractor or sub-subcontractor that will perform Work or services or otherwise be present at the Project site. Prior to the performance of any services by such employees, the criminal background check shall be performed and completed at the Contractor’s sole cost and expense. No person shall be employed by the Contractor, subcontractor or sub-subcontractor who has been found guilty of any of the criminal offenses enumerated in Ohio Revised Code Section 3319.39 or the laws of any of the other states. The Contractor shall remove (and shall cause its subcontractors and sub-subcontractors to remove) any person from the Project site found (during the criminal background check or otherwise) to have violated any of the offenses listed in Section 3319.39 of the Ohio Revised Code or equivalent provisions thereof under the laws of any of the other states. The foregoing shall not (i) be cause for any claim against the Owner for any reason, including without limitation, interference or delay, and (ii) excuse the Contractor, subcontractor and/or sub-subcontractor from meeting the construction schedule. Without limiting any other remedy the Owner may have for failure of the Contractor to comply with these provisions, the Owner may suspend the processing of Applications for Payment until the Contractor complies. (If requested, the Owner may require a Federal Bureau of Investigation criminal background check of the employees of the Contractor or of any subcontractor or sub-subcontractor. If the Owner requests such additional investigations, the Owner will do so at their own expense).
2. Contractors shall use: SELECTION.COM • 1-800-325-3609 to perform these services. An identification badge will be issued to all approved workers. **This badge will be required to be worn at all times.**
3. The Owner will allow the use of existing, completed background checks from companies who already have them for their employees. These existing background checks must have been issued no later than 9 months prior to bid opening. Existing background checks must have been issued by a certified company. The Owner has the final determination if these existing background checks will be allowed to be used. The Contractor is responsible for any rejections. New badges for this Project will still need to be obtained from SELECTION.COM.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 21 00 – ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:.
1. Contingency allowances.

C. Related Requirements:
1. Section 01 26 00 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.2 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

A. See the Bid Form for Allowances to be included in Contractor’s Base Bid.

END OF SECTION 01 21 00

SECTION 01 23 00 – ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

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

1.3 CLARIFICATIONS

A. Extent of work for each alternate is indicated on the drawings and/or in the associated technical specification sections; in case of any uncertainty request clarification from Architect before bidding, in time for addendum preparation.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other Work of the Contract.

D. Schedule: A Part 3 “Schedule of Alternates” Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate materials and their installation for each alternate with related materials and installation under other subcontracts to ensure each item is completely integrated and interfaced with related work of same and other contracts and all costs for such integration are included in the alternate Work amount.

3.2 SCHEDULE OF ALTERNATES

A. Alternate No.1: Each bidder is requested to state the addition in cost to provide triple-pane glazing with integral blinds in lieu of double-pane glazing in in all Aluminum Windows.

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
1. Administrative and procedural requirements for **Substitution requests**.
2. Administrative and procedural requirements for **Comparable Product requests**.

B. Request Form
1. Form that must be used for initiating a Substitution request or a Comparable Product request is included at the end of this Section; the use of any other form or format or process for considering a product change will be rejected without review.
a. READ AND FOLLOW THE INSTRUCTIONS FOR USE OF THIS FORM!

C. Related Requirements:
1. Section 01 60 00 "Product Requirements" for requirements applicable to products to be selected for use on the Project including those listed in individual specification Sections and those proposed by the Contractor as comparable products.

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. Changes proposed by Contractor that offer Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume.
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.

B. **Comparable Product**: Product that is demonstrated and approved, through the substitution process, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of a specified product.

C. Request for Substitution and Comparable Product Request: Written request from the Contractor to the Architect seeking the use of a product, material, equipment, or method of construction that differs from the one indicated in the Construction Documents.

1.3 ACTION SUBMITTALS

A. Substitution for Cause, Substitutions for Convenience, and Comparable Product Requests.
1. Submit fully executed request form and all substantiation documentation of each request for consideration. Do not combine multiple requests on one form.

B. Request Form: Use copy of the form provided in Part 4 of this Section only; no other form will be accepted.

C. Documentation: Type and format required to completely prove equality to specified products, materials and systems. Reference to the proposed product manufacturer’s website or catalog will not be considered responsive to this requirement.

D. Submission of a Substitution for Convenience Request or a Comparable Product Request does not mandate its review or approval. Architect has no obligation to justify or explain acceptance or rejection of any product change request; Contractor shall not protest Architect’s decision relative to this project but may discuss the proposed product with the Architect for consideration on future projects.

1.4 QUALITY ASSURANCE

A. Failure to Procure: The failure of the Contractor to procure a product or material on schedule will not be considered adequate reason for submitting a substitution request or a comparable product request unless the time required for procuring such product or material by reasonable means exceeds the time available at the Contractor's earliest opportunity to order.
   1. Contractor’s failure to make submittals in a timely manner to attain a favorable review shall not be considered justification to extend Contractor’s ‘earliest opportunity’.

B. Compatibility of Substitutions and Comparable Products: Investigate and document compatibility of proposed substitution and comparable product with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

C. Product Change after Award of Contracts: Regardless of Architect’s review and acceptance, all changes and associated cost or schedule effects required to associated materials caused by a product change after Award of Contract are the responsibility of the contractor initiating the product change. Submitter of product change request after Award of Contracts is responsible for notifying all associated work contractors of the change and for negotiating with them all differences and costs in their work.

1.5 PROCEDURES

A. Coordination: Revise or adjust all affected Work as necessary to integrate work of the approved substitutions and comparable products.

1.6 SUBSTITUTIONS FOR CAUSE REQUESTS

A. Substitutions for Cause:
   1. Will be considered after Award of Contract but no later than 30 days prior to the time required for preparation and review of related submittals.
   2. Will be considered only if submitted by a Prime Contractor.
   3. Will be considered only when accompanied by the fully executed form required (see Part 4 of this Section) and with all substantiating documentation provided by the Contractor.
      a. Reference to the proposed product manufacturer’s website or catalog will not be considered responsive to this requirement.

B. Conditions: Architect will consider Contractor's request for substitution for cause when a preponderance of the following conditions are satisfied. If applicable conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements.
   1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   2. Equal product available for lesser cost, in which case the savings to Owner shall be indicated.
   3. Specified product not available due to discontinuance or other circumstance beyond the Contractor's control.
   4. Specified product not recommended or warranted by manufacturer for intended application.
   5. Specified product not approved for use by federal, state, or local authorities having jurisdiction; provide documentation or written statement of the authority.
   6. None of the products specified meet performance or warranty requirements specified.
   7. Requested substitution does not require extensive revisions to the Contract Documents.
   8. Requested substitution is consistent with the design intent and the Contract Documents and will produce indicated results.
   9. Requested substitution will not adversely affect Project Construction Schedule.
   10. Requested substitution has received necessary approvals of authorities having jurisdiction.
   11. Requested substitution is compatible with other portions of the Work.
   12. Requested substitution provides specified performance and warranty.
   13. 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. Documentation: In addition to information requirements stated in the form included in Part 4, provide greater detail about the following:

1. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
2. Coordination information, including a list of changes or revisions needed to other parts of the Work including that of separate Prime Contractors that will be necessary to accommodate proposed substitution.
    a. Failure to document changes that will be required to other work will result in the cost of such changes being back-charged to the contractor submitting the request.
3. Detailed side-by-side comparison listing significant qualities of proposed substitution and those of the Work specified as indicated in the Form in Part 4. Provide a separate sheet if the form does not provide enough spaces. 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.
    a. Attach product data and, if applicable, drawings and descriptions of products and fabrication and installation procedures of the proposed substitution and the same information of at least one of those named in the specifications, for comparison and substantiation of the data listed in the form.
4. Samples, where applicable or requested.
5. Certificates and qualification data, where applicable or requested.
6. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
7. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
8. Research reports evidencing compliance with building code in effect for Project.
9. Detailed comparison of Project 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.
10. Cost information, including a proposal of change, if any, in the Contract Sum.
11. 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.
12. 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.

D. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 15 days of receipt of a request for substitution for cause. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
    1. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.

E. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.
    1. Regardless of any conflicting statement elsewhere in the Project Manual, Architect shall not be obligated to justify either a favorable or an unfavorable review decision.

1.7 SUBSTITUTION FOR CONVENIENCE REQUESTS

A. Substitutions for Convenience (see separate paragraph for comparable product requests):
    1. Will be considered only prior to Bidding.
    2. Will be considered only if submitted by a Prime Contract Bidder.
    3. Will be considered only when received in time for a thorough review by the Architect before deadline for issuance of an addendum is reached.
    4. Will be considered only when accompanied by the form required (see Part 4 of this Section) and with all substantiating documentation provided by the Contractor.
        a. Reference to the proposed product manufacturer’s website or catalog will not be considered responsive to this requirement.

B. Conditions: Architect may consider Contractor's request for substitution for convenience when one or more of the following conditions are satisfied. If applicable conditions are not satisfied, Architect will take no action or may return requests without action except to record noncompliance with requirements.

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume.
    a. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the design intent and the Contract Documents and will produce indicated results.
4. Requested substitution will not adversely affect the Project Construction Schedule.
5. Requested substitution has received necessary approvals of authorities having jurisdiction.
6. Requested substitution is compatible with other portions of the Work.
7. Requested substitution has been coordinated with other portions of the Work.

C. Documentation: In addition to information requirements stated in the form included in Part 4, provide the following:
1. Statement indicating why specified product or fabrication or installation is being proposed.
2. Coordination information, including a list of changes or revisions needed to other parts of the Work including that of separate Prime Contractors that will be necessary to accommodate proposed substitution.
    a. Failure to document changes that will be required to other work will result in the cost of such changes being back-charged to the Contractor submitting the request.
3. Detailed side-by-side comparison listing significant qualities of proposed substitution and those of the Work specified as indicated in the Form in Part 4. Provide a separate sheet if the form does not provide enough spaces. 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.
    a. Attach product data and, if applicable, drawings and descriptions of products and fabrication and installation procedures of the proposed substitution and the same information of at least one of those named in the specifications, for comparison and substantiation of the data listed in the form.
4. 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.
5. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of substitution to produce indicated results.

D. Architect's Action:
1. If necessary, Architect will request additional information or documentation for evaluation.
2. Form of Acceptance: Inclusion of the requested product, material, or method in an addendum issued to all bidders prior to Bidding.
3. Regardless of any conflicting statement elsewhere in the Project Manual, Architect shall not be obligated to justify either a favorable or an unfavorable review decision.

E. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.8 COMPARABLE PRODUCT REQUESTS

A. Comparable Product Requests:
1. Will be considered only prior to Bidding.
2. Will be considered only when received in time for a thorough review by the Architect before deadline for issuance of an addendum is reached;
3. **Will be considered only when accompanied by the fully executed form required** (see Part 4 of this Section) and with all substantiating documentation provided by the Contractor.
    a. Reference to the proposed product manufacturers website or catalog will not be considered responsive to this requirement.
4. Submit a separate request package for consideration of each individual comparable product desired.

B. Conditions: Architect may consider Contractor's request for comparable product when one or more of the following conditions is satisfied. If applicable conditions are not satisfied, Architect will take no action or may return requests without action except to record noncompliance with requirements.

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, including the work of others, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
2. Documentation that comparable product will not adversely affect any sustainable design credit being sought for the Project.
3. Evidence that proposed product provides specified warranties.

C. Architect's Action:
1. If necessary, Architect will request additional information or documentation for evaluation.
2. Form of Acceptance: Inclusion of the requested product, material, or method in an addendum issued to all bidders prior to Bidding.
3. Regardless of any conflicting statement elsewhere in the Project Manual, Architect shall not be obligated to justify either a favorable or an unfavorable review decision.

D. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - FORMS

A. Form begins on the next page. Use separate additional pages if necessary to list all performance criteria.

B. Use a separate form for each individual Product for which consideration of a change is being requested. Any written justifications, reasons, explanations, or statements relative to the request shall be provided on the Contractor’s letterhead, dated and signed.

C. DIRECTIONS for use of Form:
1. Contractor must submit a side-by side comparison of all pertinent specification criteria listing the performance criteria of one of the specified products along side of the same criteria of the product the Contractor would like to use instead. Use the form.
   a. In the first column, re-state the performance requirements given in the specification. List all performance, strength, size, thickness, material, warranty requirements, sustainable design contribution, selection options, and so forth specified; not just one or two.
   b. In the second column, select one of the products named in the specification section and list the corresponding performance values of that product.
   c. In the third column. list the corresponding performance values of the product being submitted for consideration.
2. Architect will review Requests for Substitution for Cause, Requests for Substitution for Convenience, and for use of Comparable Products only when submitted using this form and with all supporting documentation included.
3. Regardless of any conflicting statement elsewhere in the Project Manual, Architect shall not be obligated to justify either a favorable or an unfavorable review decision.

continued

SUBSTITUTION REQUEST FORM

Project:_____

SHP Project Number:_____date_____

NOTE:

This form is to be used for Substitutions and Comparable Product Requests during bidding. Substitution-for-Cause Requests after bidding will be considered only for extreme justification and substantial benefit to the Owner as described elsewhere in the Documents, and with compensation to the Architect for evaluation time.

We hereby request the following be considered as an acceptable product / material / manufacturer for the above referenced project.

Section and Paragraph No.	Specified Manufacturer and Product	Proposed Substitution
_____	_____	_____

***DIRECTIONS**: List **all** specified performance criteria of **one of the products named** in the specification and then the corresponding criteria of the proposed substitution product. Include performance criteria, referenced standards, codes, color / texture selection availabilities, sustainable design criteria, and warranty data. Provide a separate form for each product to be considered.*

Criteria Description	Specified Product Provides / Meets	Proposed Product Provides / Meets
1_____	_____	_____
2_____	_____	_____
3_____	_____	_____
4_____	_____	_____
5_____	_____	_____
6_____	_____	_____
7_____	_____	_____
8_____	_____	_____
9_____	_____	_____
10_____	_____	_____
11_____	_____	_____
12_____	_____	_____

It is understood and expressly agreed that the submitter has investigated the potential effects of the use of the comparable product / substitution and accepts full responsibility for all consequential affects including but not necessarily limited to the following relative to the use of the proposed item:

Effects on other construction including other Contracts; Effects on the Project Construction Schedule; Fitness for the use intended; Equivalency to that specified; Acceptability by authorities having jurisdiction; Safety when used as indicated.

In submitting this form, Contractor understands and agrees that the Architect has no obligation to justify or explain acceptance or rejection of a substitution or comparable product request.

Substitution Request Form – page 1 of 2

For Requests considered after Award of Contract, the Contractor's responsibility includes but is not necessarily limited to: Cost of adjustments to other Work including modifications to work in place; compensation for construction delays, compensation for evaluations by the Architect, consultants and other contractors. *(Complete entire Substitution Request Form)*

Justification: *For Request **after bidding** list at least three significant reasons and Owner benefits for why the proposed substitution should be considered; Architect may request additional justifications*:

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

Include with this form all additional product literature and information necessary for the Architect to verify data stated in this form and to properly compare the requested product with the specified product. The Architect will not be responsible for delays caused by lack of information. Architect makes no assurances that proposed comparable product will be evaluated in time to be included in the Project by Addendum; Bid Date will not be extended for comparable product / substitution request consideration.

Submitted by:

_____
Company

_____
Address 1

_____
Address 2

_____
Phone

_____
Fax

_____
E-mail

_____
Name and Signature

SHP ACTION:

☐ Approved ☐ Rejected By: _____ Date: _____

Note:
Regardless of action indicated, return or non-return of this form to the submitter has no legal bearing on acceptance or rejection of a proposed product, manufacturer, or method. Proposed changes are officially accepted for use in the Project only when included in the Contract during bidding by Addendum or (after award) in the Contract by Change Order.

Substitution Request Form – page 2 of 2

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710-2017, "Architect's Supplemental Instructions."

1.3 PROPOSAL REQUESTS

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

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
   1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
   2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   4. Include costs of labor and supervision directly attributable to the change.
   5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
   7. Proposal Request Form: Use forms acceptable to Architect.

1.4 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

A. Comply with requirements of Division 00 Section “General Conditions” article 7 as amended by Supplementary General Conditions.

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:
1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule..>

1.2 DEFINITIONS

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

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
   a. Project name and location.
   b. Owner's name.
   c. Name of Architect.
   d. Architect's project number.
   e. Contractor's name and address.
   f. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
5. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
6. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
7. In addition to the Contractor’s construction activities, the Contract Cost Breakdown must include the following line items with the associated percentage of the contract value allocated to that activity.
   a. Progress Meeting Attendance - 0.5% of the Contract.
   b. Record Drawing Updates.
   c. Allowances.

d. Temporary Facilities.
e. Correction of punchlist items - 0.5% of the Contract.
f. Specified Training – 1% of the Contract.
g. Bonds: Insurance, permits and tests.
h. Mobilization.
i. Demobilization.
j. Submittals in the amount of 2% of the Contract; however, not less than $1,000.00 nor more than $10,000.00.
k. Daily clean up.
l. Final Cleaning.
m. Closeout costs in an amount equal to 1% of the Contract amount; however, not less than $500.00 or more than $10,000.00.

8. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:
a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit one signed and notarized original copy of each Application for Payment to Architect by e-mail by agreed upon monthly submittal date. Include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. Executed contract.
2. List of subcontractors.
3. Schedule of values.
4. Contractor's construction schedule (preliminary if not final).
5. Products list (preliminary if not final).
6. Schedule of unit prices. Submittal schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 77 00 "Closeout Procedures."
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
6. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
7. AIA Document G707-1994, "Consent of Surety to Final Payment."
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. RFIs.
   4. Project meetings.

B. Related Requirements:
   1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
   2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. RFI: Request for Information. Request from Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of list in Project meeting room, in temporary field office, and in prominent location inbuilt facility. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

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

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to coordination drawingsin a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling, raised access floor, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.

c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Submittal Format: Submit or post coordination drawing files using PDF format.

1.6 REQUESTS FOR INTERPRETATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
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 so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
2. Owner name
3. Name of Architect.
4. Architect's Project number.
5. Date.
6. Name of Contractor.
7. RFI number, numbered sequentially.
8. RFI subject.
9. Specification Section number and title and related paragraphs, as appropriate.
10. Drawing number and detail references, as appropriate.
11. Field dimensions and conditions, as appropriate.
12. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
13. Contractor's signature.
14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
   1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow three working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for approval of Contractor's means and methods.
      d. Requests for coordination information already indicated in the Contract Documents.
      e. Requests for adjustments in the Contract Time or the Contract Sum.
      f. Requests for interpretation of Architect's actions on submittals.
      g. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
   3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
      a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Include the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect.
   4. RFI number, including RFIs that were returned without action or withdrawn.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's response was received.
   8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
   9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
   1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Responsibilities and personnel assignments.
      b. Tentative construction schedule.
      c. Phasing.
      d. Critical work sequencing and long lead items.
      e. Designation of key personnel and their duties.

f. Lines of communications.
g. Procedures for processing field decisions and Change Orders.
h. Procedures for RFIs.
i. Procedures for testing and inspecting.
j. Procedures for processing Applications for Payment.
k. Distribution of the Contract Documents.
l. Submittal procedures.
m. Preparation of Record Documents.
n. Use of the premises and existing building.
o. Work restrictions.
p. Working hours.
q. Owner's occupancy requirements.
r. Responsibility for temporary facilities and controls.
s. Procedures for moisture and mold control.
t. Procedures for disruptions and shutdowns.
u. Construction waste management and recycling.
v. Parking availability.
w. Office, work, and storage areas.
x. Equipment deliveries and priorities.
y. First aid.
z. Security.
aa. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.
   1. Conduct the conference to review requirements and responsibilities related to Project closeout.
   2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
      a. Preparation of Record Documents.
      b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
      c. Submittal of written warranties.
      d. Requirements for preparing operations and maintenance data.
      e. Requirements for delivery of material samples, attic stock, and spare parts.
      f. Requirements for demonstration and training.
      g. Preparation of Contractor's punch list.
      h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
      i. Submittal procedures.
      j. Coordination of separate contracts.
      k. Owner's partial occupancy requirements.
      l. Installation of Owner's furniture, fixtures, and equipment.
      m. Responsibility for removing temporary facilities and controls.
   4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at weekly intervals.
   1. Coordinate dates of meetings with preparation of payment requests.
   2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
         1) Review schedule for next period.
      b. Review present and future needs of each entity present, including the following:
         1) Interface requirements.
         2) Sequence of operations.
         3) Status of submittals.
         4) Deliveries.
         5) Off-site fabrication.
         6) Access.
         7) Site use.
         8) Temporary facilities and controls.
         9) Progress cleaning.
         10) Quality and work standards.
         11) Status of correction of deficient items.
         12) Field observations.
         13) Status of RFIs.
         14) Status of Proposal Requests.
         15) Pending changes.
         16) Status of Change Orders.
         17) Pending claims and disputes.
         18) Documentation of information for payment requests.
   4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Contractor's construction schedule.
   2. Daily construction reports.
   3. Existing condition reports.
   4. Unusual event reports.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.
   1. Float time belongs to Owner.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
   1. PDF file.

B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at weekly intervals.
   1. Existing Condition Reports: Submit at time of discovery of differing conditions.

G. Unusual Event Reports: Submit at time of unusual event.

1.4 COORDINATION

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

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Indicate start and completion dates for the following as applicable:
a. Securing of approvals and permits required for performance of the Work.
b. Temporary facilities.
c. Construction of mock-ups, prototypes and samples.
d. Owner interfaces and furnishing of items.
e. Interfaces with Separate Contracts.
f. Regulatory agency approvals.
g. Punch list.
3. Procurement Activities: Include procurement process activities for long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:
a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Uninterruptible services.
d. Partial occupancy before Substantial Completion.
e. Use-of-premises restrictions.
f. Provisions for future construction.

g. Seasonal variations.
h. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Building flush-out.
   m. Startup and placement into final use and operation.
8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. Structural completion.
   b. Temporary enclosure and space conditioning.
   c. Permanent space enclosure.
   d. Completion of mechanical installation.
   e. Completion of electrical installation.
   f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
   1. See Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   1. Unresolved issues.
   2. Unanswered Requests for Information.
   3. Rejected or unreturned submittals.
   4. Notations on returned submittals.
   5. Pending modifications affecting the Work and the Contract Time.

H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate Final Completion percentage for each activity.

I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

J. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
   a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
   f. Utility interruptions.
   g. Installation.
   h. Work by Owner that may affect or be affected by Contractor's activities.
   i. Testing and inspection.
   j. Punch list and Final Completion.
   k. Activities occurring following Final Completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.

9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
   a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
   b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.7 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Existing Condition Reports: Immediately on discovery of a difference between existing conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:
1. Preconstruction photographs.

B. Related Requirements:
1. Section 02 41 19 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.
1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag:
a. Name of Project.
b. Name of Architect.
c. Name of Contractor.
d. Date photograph was taken.
e. Description of location, vantage point, and direction.
f. Unique sequential identifier keyed to accompanying key plan.

1.3 RIGHTS

A. Ownership and copyright privileges of photographic images belong to the Owner and the Architect. Under penalty of Law, the Contractor shall not provide or transmit in any manner construction photographs to any entities except the Owner and the Architect without written authorization from the Architect.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time from camera.

D. File Names: Name media files with date, Project area, and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.
1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.
1. Take photographs of existing buildings on property to accurately record physical conditions at start of construction.

2. Take photographs of existing pavements, landscaping, and lawn areas at building perimeter to accurately record physical conditions, especially settlement or cracking, at start of construction. Include photographs at material and equipment staging areas, locations of material hoisting equipment, and locations of dumpsters and demolition debris removal chutes.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Submittal schedule requirements. Administrative and procedural requirements for submittals.
2. Web-based file sharing system.
3. Use of digital data files.

B. Related Requirements:
1. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings.
2. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports.
3. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
4. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
5. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. BIM: Building Information Modeling.

D. ShareFile: Web-based file sharing site, owned by Citrix Systems, which will be utilized to organize and exchange submittals. Access to ShareFile is available through Architect at no cost.

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Submit concurrently with the first complete submittal of Contractor's construction schedule.
a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
3. All initial shop drawings / action submittals are required to be submitted within 90 days of Notice to Proceed.
4. Format: Arrange the following information in a tabular format:
a. Scheduled date for first submittal.
b. Specification Section number and title.
c. Submittal Category: Action; informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Architect's final release or approval.

1.4 SUBMITTAL FORMATS

A. Transmittal: Include the following information on transmittal form:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier.
    1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Maintain a single numeric sequence regardless of whether an individual submittal is physical or electronic.
    2) Resubmittals shall include an alphanumeric suffix after another decimal point (e.g., 061000.01.R1).
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Location(s) where product is to be installed, as appropriate.
13. Other necessary identification.
14. Remarks.
15. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

1.5 SUBMITTAL PROCEDURES

A. 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.
3. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received. Processing time starts when related submittals are received.

B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows.
1. Time for review shall commence on Architect's receipt of submittal whether physically delivered to Architect’s office or electronically delivered to ShareFile.
2. Review time concludes upon Architect’s date of return-transmittal form whether physically delivered to Contractor or electronically delivered to ShareFile.
3. 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.
4. Required processing times are as follows regardless of any conflicting statement made elsewhere:
    a. 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.
        1) Color selections: For submittals that require a color or texture selection by the Architect, submit physical samples in advance of electronic submission.
    b. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
    c. Resubmittal Review: Allow 14 days for review of each resubmittal.
    d. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

C. Resubmittals: Make resubmittals in same form 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. **Repetitious resubmittals** not complying with previous submittal annotations will result in back-charges against the Contractor for excessive Architect / Consultant review time.
    a. This applies whenever a resubmittal must be revised and resubmited due to non-compliance with a previous annotation. If there is any question about an annotation that the submitter feels cannot be followed, the submitter must initiate discussion with the Architect, not simply ignore the annotation.
    b. Back-charges assessed for these reasons must be paid directly to the reviewing entity in advance of the Contractor's next partial Application for Payment or payment request will not be processed.

D. Processing Electronic Submittals:
1. Assemble all documents of a submittal, including transmittal, into a single PDF. Do not combine multiple submittals into the same PDF. Before creating PDF, ensure the following:
    a. Documentation is complete and in compliance with the Contract Documents.
    b. Product selections and options intended to be provided are *clearly* selected and identified in the submittal.
        1) Failure to identify selections may result in rejection of the submittal without further review.
    c. Where Architect selections are needed, ensure the available selections are clearly identified in the submittal; where color or texture selections by the Architect are needed, Contractor is required to submit actual physical samples; no color will be selected from electronic submissions.
    d. Contractor has stamped, signed, and dated their confirmation that the submittal is correct, complete, and in compliance with Contract Documents.
2. Ensure PDF is legible in both electronic (screen) version AND printed version.
    a. In general, create PDF from an original electronic file rather than from a scanning process.
    b. Illegible PDFs will be returned to Contractor without review.
    c. No change in Contract Time will be authorized for Contractor's failure to provide actionable PDF submittals.
3. Upload PDF to designated folder on ShareFile website and email Architect accordingly. Architect will email Contractor when submittal review is complete and ready for Contractor's download. Architect will provide ShareFile access instructions and detailed submittal routing procedures at pre-construction meeting.
4. Retrieve completed submittals from the ShareFile website, maintain its own electronic file of all completed submittals, and shall provide paper copies of submittals as may be needed for field installation or its own purposes.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
1. For Construction: Provide paper copies of shop drawings, wiring diagrams, and other submittals containing installation requirements for use on the project site.
    a. Provide additional sets or partial sets needed by the Contractor's own workers while performing the installation. Do not perform installation without having paper copy of final shop drawings present in the work area.
    b. Use only final submittals bearing the stamp mark of the Architect indicating that the submittal is acceptable for construction use under the conditions indicated.
2. For Authorities having Jurisdiction: For contractor-obtained permits and other contractor provided information required by authorities having jurisdiction, assemble complete documentation, drawings, and forms for the submission into a single PDF as required by the authority for electronic submission. Attach a signed transmittal form or cover letter on contractor's letterhead addressed to the authority; include information on method of payment of fees where applicable. Transmit to authority electronically with copy to Architect unless:
    a. If Authority requires submission be made by the Architect or engineer of record: Provide to Architect who will review the submittal and then forward it (including Contractor's cover letter) to the Authority under Architect's transmittal form.
    b. If Authority requires hardcopies: provide number of physical copies required by the authority and process direct or via Architect as indicated above.
3. For Operation and Maintenance Manuals: Provide 'clean' paper copies of all electronic submittals required and integrate with documents that were processed originally as physical submittals. Do not provide paper copies that have been damaged or marked-up by construction use.

a. Additionally, for all submittals that were processed electronically, include all final submittals on a CD, cataloged in the same order as required for the physical O&M manual, and furnish to Owner as part of the Manual.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
a. Manufacturer's catalog cuts.
b. Manufacturer's installation instructions.
c. Color samples.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.
3. Processing:
a. Submit actual-material Samples, with transmittal, to Architect for review and action.
b. Upload PDF of transmittal to ShareFile website including digital image file illustrating Sample characteristics and identification information for record.
c. Architect will transmit review action to Contractor through ShareFile.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected rom manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; remainder will be returned to jobsite.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:
   1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
   2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
   3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
   4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
   5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
   6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:
   1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
   2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
   3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

I. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

J. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal to proper entity.

1.7 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
2. If Specifications require that the actual shop drawings or actual calculations pages be signed and sealed by the delegated design professional, in addition to the above, provide three paper copies of the final reviewed documents bearing the engineer’s seal and signature directly on each document.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
1. Do not process submittals that do not comply with requirements.
2. Do not process submittals that are not clearly marked to indicate the specific products and specific product options.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
   1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Requirements of this Section are intended to supplement requirements of the General and Supplementary Conditions. Any reference herein, in the General Conditions, or elsewhere in the Project Manual, to Architect's "Approval" of any submittal shall not be construed as the Architect assuming any responsibility of the Contractor or any other entity, nor acceptance of any product or work not in conformance with the Contract Documents.

B. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Incomplete submittals, including submittals that do not highlight specific product choices or options, are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents will be returned by Architect without action.

F. Submittal of un-named products when a Section includes a list of acceptable products will be returned by Architect without review. Comply with Section 01 25 00 "Substitution Procedures" for *consideration* of substitutions and comparable products.

G. Architect will not review submittals that do not bear Contractor's approval stamp and will return them 'rejected' without further action.

1.10 ARCHITECT'S DIGITAL DATA FILES

A. Architect's Digital Data Files: Electronic copies of individual Contract Drawing Plan Sheets *may* be furnished upon request solely for Contractor's use in preparing submittals and solely for use on this project. Any other use of these drawings is a prosecutable violation of terms of use.
   1. **For Architect's drawings**, Contractor must make written request for specific sheets and comply with all requirements indicated in the "Agreement and Waiver for Use of Architect's Electronic Documents" form in Part 4 of this Section.
   2. **For other Consultants'** (Non-SHP) drawings, contact the individual consultant and comply with that consultant's separate waivers, and agreements.
   3. Availability and format depends on drawing type and drawing production methods used. Availability is not guaranteed.
   4. Drawings will be stripped of all titles, seals, dimensional and text information.
   5. Active BIM Model is not available for Contractor use.
   6. No claims for additional time will be accepted from any Contractor for the time it takes the Architect or their consultants to prepare and transmit the requested electronic files for the Contractor's use.

B. Photocopy the appropriate Agreement / Waiver form starting at the end of this Section. Provide all information requested completely. Sign and date at the bottom to indicate understanding and acceptance of all terms and conditions contained in the form.

C. Indicate the desired electronic format and version and the sheet numbers of the desired sheets in the spaces allotted at the bottom of the form.

D. Submit form to the Architect or consultant as appropriate following directions on the form.

E. For use of other Consultant's electronic documents, contact the consultant directly and comply with their requirements and waivers.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

PART 4 - FORMS

4.1 Agreement and Waiver form begins on next page.

AGREEMENT AND WAIVER FOR USE OF ARCHITECT'S ELECTRONIC DOCUMENTS

This agreement is made on: (date) _____.

By Contractor: (company name) _____.

Address,
City, State, Zip: _____.

To the Architect: SHP, 312 Plum Street, Suite 700
Cincinnati, Ohio 45202 (fax 513-381-5121)

In consideration of the Contractor's limited use of copies of the Architect's electronic documents, the Contractor agrees as follows:

OWNERSHIP AND USE OF ARCHITECT'S DRAWINGS

1 Electronic Documents

1.1 The Architect, at their sole discretion and without obligation, will make graphic portions of plan-view Contract Drawings available for use by the Contractor in electronic format. These electronic documents shall be for use solely with respect to this single Project as provided in the Standard Form of Agreement between Owner and Architect.

1.2 These electronic documents will be provided in .DWG format for AutoCAD 2013.

1.3 The electronic documents provided will be stripped of the Project's name and address, the Architect's and their consultant's name and address, any professional licenses indicated on the Contract Documents, and all dimensions, verbiage, and statistical information. Detail drawings are not available in electronic format.

1.4 Use of these electronic documents is solely at the Contractor's risk, and shall in no way alter the Contractor's Contract for Construction.

1.5 The Architect makes no representation regarding fitness for any particular purpose, or suitability for use with any software or hardware, and shall not be responsible or liable for errors, defects, inexactitudes, or anomalies in the data, information, or documents (including drawings and specifications) caused by the Architect's or its consultant's computer software or hardware defects or errors; the Architect's or its consultant's electronic or disk transmittal of data, information or documents; or the Architect's or its consultant's reformatting or automated conversion of data, information or documents electronically or disk transmitted from the Architect's consultants to the Architect. The Contractor waives all claims against the Architect, its employees, officers and consultants for any and all damages, losses, or expenses the Contractor incurs from defects or errors in the electronic documents. Furthermore, the Contractor shall indemnify, defend, and hold harmless the Architect, and its consultants together with their respective employees and officers, from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorney's fees and litigation expenses) attributed to errors or defects in data, information or documents, including drawings and specifications, resulting from the Contractor's use or distribution of electronic documents to other contractors, persons, or entities.

The undersigned agrees to the terms and conditions contained herein.
Contractor Signature:

By: _____.

Title: _____.

Electronic Format Desired: _____.

Email address to send electronic documents: _____

Sheets Desired:

_____. _____. _____. _____. _____. _____. _____.

_____. _____. _____. _____. _____. _____. _____.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
1. Mockups are used for one or more of the following:
   a. Verify selections made under Sample submittals.
   b. Demonstrate aesthetic effects.
   c. Demonstrate the qualities of products and workmanship.
   d. Demonstrate successful installation of interfaces between components and systems.
   e. Perform preconstruction testing to determine system performance.
2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED-DESIGN SERVICES

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

B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

C. During construction, Contractor will be instructed to provide the greater quantity or quality. No increase in the Contract Amount will be considered for Contractor bidding the lower quality and lesser quantity instead of seeking clarification during bidding.

1.5 INFORMATIONAL SUBMITTALS

A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports and documents as specified.

D. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies and mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. When testing is complete, remove test specimens, test assemblies, and mockups; do not reuse products on Project.
6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
   a. Construct mockups showing exterior elements in an open, unshaded area with the finish side of the mockup facing south.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed, unless otherwise indicated.

L. Specialty Mockups: See Section 01 43 39 "Mockups" for additional construction requirements for integrated exterior mockups.

1.8 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made by the Owner.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.9 SPECIAL TESTS AND INSPECTIONS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities’ having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."

B. Protect construction exposed by or for quality-control service activities.

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

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the General Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity or to resolve any construction activity uncertainty or dispute, contractor shall immediately obtain copies of the relevant standard directly from publication source and keep on site for reference by all entities.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
5. OBC – Ohio Building Code.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.govinfo.gov.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES Retain "General" Paragraph below to prevent claims for unforeseen temporary facilities costs.

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: 120 volt electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

D. No other public utilities are provided on the site; all other utilities required for construction shall be provided by the Contractor as temporary facilities.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

C. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation.

E. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
1. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

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

2.2 TEMPORARY FACILITIES

A. General: Contractor is responsible for all temporary facilities needed including but not limited to:
1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.
2. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.
3. Hoses for water to location needed.
4. Storage and fabrication sheds.
5. All safety devices and precautions necessary for operations and work.
6. Provide, maintain and perform protection and prevention of fires or fire hazards during the construction period for its construction material and personnel in accordance with Federal, State and Local laws and regulations. This includes but is not limited to fire extinguishers, special signs and removal of combustible materials.
7. Staging and scaffolding for its own construction activities.
8. Waste disposal facilities, including collection and legal disposal of its own waste materials. Daily cleanup of Contractor's trash & debris is mandatory for this project and is included in the Contract.
9. Secure lockup of tools, materials, and equipment.
10. Construction aids and miscellaneous services and facilities necessary exclusively for construction activities.
11. Means and methods of construction and jobsite safety.
12. Contractor is similarly responsible for the activities of its subcontractors.

B. Common-Use Field Office is contractor option; progress meetings may be held in the existing building in lieu of on-site if scheduled in advance with the Owner; or may be held on site in the open. If provided, office trailer shall be of sufficient size to accommodate needs of construction personnel, inspectors, architect, and contractor's office activities and to accommodate Project meetings. Furnish and equip offices as follows:
1. Location: Parking lot; position as approved by Owner.
2. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
3. Provide secure location for copy of reviewed submittals, permits, permit drawing sets and other official documents, and for as-built markup drawings and specification sets.
4. Provide tackboard for posting required documents, project information, telephone lists including emergency numbers for fire, police and life squad, safety posters and the like.
5. Desks for contractor.
6. Area of sufficient size to accommodate meetings of 10 individuals.
7. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
8. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. IF NO field office is provided: Provide weather-tight lockable gang box of sufficient size to accommodate record documents, permit drawings, shop drawings, notice board and other required informational documents.
1. This document gang box shall be a separate dedicated item, not part of contractor's tool and equipment gang box. Furnish with combination padlock and advise owner and architect of combination or provide key padlock with keys issued to owner and architect.
2. Contractor is responsible to ensure gang box is secured on site against theft and damage.
3. Document gang box shall be available to all authorized entities during construction hours.

D. Sanitary Facilities: Provide and maintain temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Remove trash from site daily or provide dumpster adequate for all waste material and debris at end of each day; service as required.
   1. Allow no loose material piles or fenced debris containment areas.

F. Enclosure Fence: Contractor option to enclose staging area. Use portable chain link fencing that does not penetrate or damage pavement. Contractor must secure any openings in the building envelope during window and door replacement processes.

G. Barricades, Warning Signs, and Lights: Provide safety devices and protections as required by work or by authorities having jurisdiction including but not limited to structurally adequate barricades, fences, warning signs and lighting.

H. Storage and Fabrication Sheds: Contractor may provide sheds sized, furnished, and equipped to accommodate materials and equipment for their construction operations.
   1. Store combustible materials apart from building.
   2. Locate as directed by Construction Coordinator.

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

J. First Aid: Maintain first aid kit adequate for all common construction needs and injuries. Kit must be unlocked and accessible for quick retrieval at all times construction is underway.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
   1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations if requirements exceed the capacity of Owner’s existing 120 volt electric power service. Maintain Owner’s existing power equipment in a condition acceptable to Owner.

3.3 SUPPORT FACILITIES INSTALLATION

A. Temporary Use of Existing Permanent Drives, Walks, and Paved Areas: Photo-document condition of existing driveways, parking lots and sidewalks used for construction purposes and access. Show in particular any condition that may later be interpreted as construction damage.
   1. Maintain paved areas in good undamaged condition. Review conditions daily and immediately assess any inadvertent damage and identify cause / responsible contractor.
   2. Contractor shall provide protective means they deem necessary to protect against pavement damage from their operations.

B. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."

D. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

E. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

E. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.
1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
1. Administrative and procedural requirements for selection of products for use in Project.
2. Product delivery, storage, and handling.
3. Manufacturers' standard warranties on products.
4. Special warranties.

B. Related Requirements:
1. Section 01 25 00 "Substitution Procedures" for requests to submit consideration of **comparable products**.
2. Section 01 25 00 "Substitution Procedures" for requests for **substitutions**.
3. Section 01 42 00 "References" for applicable industry standards for products specified.
4. Section 01 77 00 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, which is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product that is demonstrated and approved through Section 01 25 00 “Substitution Procedures” process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of a specified product.
a. Comparable products are allowed only under conditions and processes described in Section 01 25 00 “Substitution Procedures”.

B. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis-of-design” product, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating equivalent features of products of other manufacturers named in the specification.
1. Designating one product or manufacturer as the “Basis-of-Design” does not either directly or unintentionally establish a proprietary specification. It is fully expected that the other named manufacturers have standard or modified products, with or without accessory and supplementary items or methods of installation that provide equivalent utility, function, properties and design intent to the basis of design.
2. Any Contractor needing clarification about the acceptability of a product or method of installation of one of the other named manufacturers shall seek clarification from the architect during bidding by submitting complete documentation for the intended product and a written statement of intent. Submit full substantiating documents in time for Architect’s review and analysis before the cutoff date for issuing an Addendum.
3. If clarification is not requested as required during bidding, comply with the Architect’s instructions during Submittals Process that establish other named manufacturer product equivalency to the basis-of-design product; or provide the basis-of-design product.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named

manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications.

1.3 SUBSTITUTIONS / COMPARABLE PRODUCTS

A. Contractor substitution requests for convenience or for cause; and requests to use comparable products, will be considered only when presented in compliance with Section 01 25 00 “Substitution Procedures”.

B. Failure to process or order in a timely manner:
1. Failure to process product submittals or to order materials, in time to meet construction schedule requirements is not justification for providing any product or method that differs from the Construction Documents.
2. IF a substitution for cause is acceptable to the Architect, any and all costs associated with the substitution including but not limited to, providing a superior product to the one specified, expedited deliveries, special production runs, custom modifications or finishes, and adjustments to other Work in place or yet to be installed, shall be paid by the Contractor who’s failure to process or order in a timely manner has caused the change. In no case shall any cost be passed on to the Owner for such failure.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other Contractors. Date of Architect’s favorable review shall be the date used in determining precedence.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used. Provide products determined by architect with no additional cost to Owner.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.
3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

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

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
3. Warranty initiation date shall be the date indicated in the applicable specification section. Contractor shall obtain any additional, supplemental, or extended insurance necessary to cover insurances for the time period indicated if manufacturer-provided insurance does not cover the full timeframe required.
4. There shall be no delay in the initial start and continuation in effect of any warranty required by the Specifications for any cause, including but not limited to any obligations of performance or payment of fee(s), or other requirement between the Contractor and the product manufacturer / warranty provider.
    a. Where a fee is required to initiate and bring into effect or to maintain a Warranty, the Contractor shall pay such fee(s) as part of the Work and shall provide proof of payment of fees and proof of initiation of Warranty before Final Payment request will be processed.
5. Warranties shall not be suspended, terminated, or revoked due to any failure of the Contractor or their sub-contractor to pay premiums or initiation-of-warranty fees.
6. For the full duration of the warranty period, an executed warranty as delivered to the Owner shall not be suspended, terminated or revoked by the manufacturer or Contractor without written documentation signed by an officer of the manufacturer and delivered to the Owner by registered mail.
7. Manufacturer Direct Inspections for Warranty Continuance: All fees for the product manufacturer’s inspections required to maintain a warranty in full force and effect throughout the warranty period shall be waived or be pre-paid and included as part of the construction Work; this applies whether the manufacturer uses their own forces or contracts with an inspection agency. This does not apply to regular maintenance inspections and service obligations of the Owner.
8. Contractor is responsible to pay all fees and to obtain any and all additional warranties or warranty extensions necessary to fulfill the requirements of this section and of specific Product Section warranties including but not limited to warranty initiation date, warranty initiation fee payments, periodic inspection costs if required by the warranty, warranty termination date, and warranty work coverage, as part of the Work without additional cost to the Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms, dates, and identification, ready for execution.
1. Manufacturer's Standard Form: Modified or appended to include Project-specific information and requirements, properly executed.
    a. Modifications of standard form to be initialed by all parties to the agreement.
    b. Appended documents to be referenced by modification to the standard form and both documents to be cross-referenced by title and date.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time:
1. Sample Warranty / Form: un-executed, but with terms clearly indicated, when listed in a specification Section under Part 1 article “Informational Submittals”.
2. Executed Warranty / Form: Comply with requirements in Section 01 77 00 "Closeout Procedures."

D. Product Warranty Prerequisite: Specified warranties are as much a requirement of products as performance criteria. Do not submit products that cannot be covered by the specified warranty whether or not listed in the specification section; seek clarification from Architect in advance. See Section 01 25 00 “Substitution Procedures”.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Provide anchorage devices suited to conditions and that will maintain strength throughout the life of the installation without loosening, failure, deterioration, rust or staining.
3. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
4. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
5. Where products are accompanied by the term "as selected," Architect will make selection.
6. Where products are accompanied by the term "match sample," sample to be matched is Architect's; or Architect will advise specific location / criteria to be matched.
7. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
8. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article in Section 01 25 00 “Substitution Procedures” to obtain approval for use of a particular unnamed product.

B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor convenience will not be considered.
a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor convenience will not be considered.
a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.
    a. Any contractor needing clarification about the acceptability of a product or method of installation of one of the other named manufacturers shall seek clarification from the Architect during bidding by submitting complete documentation for the intended product and a written statement of intent.
        1) Submit full substantiating documents in time for Architect’s review and analysis before the cutoff date for issuing an addendum.
        2) If clarification is not requested as required during bidding, comply with the Architect’s instructions during the Submittals Process that establish other named manufacturer product equivalency to the basis-of-design product; or provide the basis-of-design product.

C. Visual Matching Specification: Where Specifications require "match Architect's sample" including to “match an established sample or element of an existing building” provide a product that complies with requirements and also matches Architect's sample or indicated element. Architect's decision will be final on whether a proposed product matches.
    1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of another product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's ‘Standard’, ‘Full’, or ‘Industry’ range of colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements and the following:
    1. Standard Range: Or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items / finishes.
    2. Full Range: Or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items / finishes.
    3. Industry Range: Or similar phrase, Architect will select a product from the manufacturer indicated and that is a regular offering in the industry even if it may be a special offering by the named manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: ONLY as indicated and following the processes stated in Section 01 25 00 “Substitution Procedures.”

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
1. Installation of the Work.
2. Cutting and patching procedures applicable to **ALL Divisions of the Work**.
3. Coordination of Owner's portion of the Work.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Requirements:
1. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
2. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.
3. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

C. "Cutting and patching" is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed, and for other similar purposes.

D. Cutting and patching performed during the manufacturer of products or during the initial fabrication, erection, or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching".

1.3 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.
1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
a. Contractor's superintendent.
b. Trade supervisor responsible for cutting operations.
c. Trade supervisor(s) responsible for patching of each type of substrate.
d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Fire-detection and -alarm systems.
    j. Conveying systems.
    k. Electrical wiring systems.
    l. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Sprayed fire-resistive material.
    e. Equipment supports.
    f. Piping, ductwork, vessels, and equipment.
    g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing site survey, topography, and subsurface conditions: Existing conditions presented in drawing, report or specification form are believed accurate within normal industry tolerances but are not guaranteed. Investigate, survey, confirm and verify all conditions bearing on the Work by any means necessary before starting any Work that changes existing conditions. Report any unacceptable discrepancies to the architect in writing before beginning operations.
1. Written claims of difference shall be accompanied by all substantiating evidence necessary to document such claim.
2. Claims of difference shall be resolved, including determination of quantities and costs and methods of Contract Modification, before work that alters such existing conditions is started.
3. Initiation of site-clearing, soil-moving operations, demolition or other activity that alters existing conditions shall be evidence that Contractor has made all investigations and evaluations it deems necessary and has accepted all existing conditions present whether or not they conform exactly to the Contract Documents.
4. Without advance written notification of unacceptable discrepancy, no claim for extra will be considered for a claim of difference between documents and actual conditions after the contractor has altered existing conditions.

B. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

D. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

E. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

F. Concealed Conditions: Concealed conditions that the Contractor believes to differ substantially from Contract requirements, that change the products or performance requirements indicated, or that otherwise have a time / cost impact on the Contractor's work shall be brought to the attention of the Architect immediately upon discovery.
1. Verbal or written claims of difference shall be accompanied by all substantiating evidence necessary to document such claim. Verbal claims shall be documented in writing by the Contractor following discussions including full description of claim and points of understanding.
2. Claims of difference shall be resolved in writing, including determination of quantities and costs and methods of Contract Modification, before work that alters such existing conditions is started.
    a. When actual quantities remain concealed at time of discovery, the unknown quantities shall be estimated and a unit price agreed upon; as work progresses, Contractor shall track and document actual quantities to the Architect daily and shall not exceed estimated quantities without specific notification and further discussion.
3. Without such written agreement no claim for extra will be considered for a claim of difference between documents and actual conditions after the Contractor has altered existing conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

E. Drawings:
1. Although Drawings are grouped and identified by classification of the Work, Contractors are responsible for their Work as it may be indicated on any and all of the Drawings regardless of drawing number prefix.
2. Although the majority of the Drawings are "to scale," Contractors are directed to use indicated written dimensions along with their own field measurements and verifications for determining locations, material quantities and for other reasons.
    a. Most plan drawings have a one-inch 'reference line' left of the title block box containing the sheet number. Be aware that if this reference line does not measure exactly one inch in length, the sheet has not been reproduced at a correct size.

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 108 inches in occupied spaces and 96 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.4 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching with Owner.

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.5 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
   a. Use containers intended for holding waste materials of type to be stored.
4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
5. Contractors failing to clean their work areas as indicated and directed will be back-charged costs for having the work performed.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.7 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.

B. Related Requirements:
   1. Section 01 29 00 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
   2. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
   3. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Section 01 79 00 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner’s signature for receipt of submittals.
5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 01 29 00 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Contractor.
      e. Page number.
   4. Submit list of incomplete items in the following format:
      a. PDF Electronic File: Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
   1. Submit by uploading to web-based project software site.

E. Provide one paper copy of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
      a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.

d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:
1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 01 91 13 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:
1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual

directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with the applicable printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
   4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
   5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Title Page: Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name and contact information for Contractor.
   6. Name and contact information for Architect.
   7. Name and contact information for Commissioning Authority.
   8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
   9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no

designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.

3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate

references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.

5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Requirements:
   1. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
   2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Submit PDF electronic files of scanned Record Prints. Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1.3 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
   1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an acceptable drawing technique.
      c. Record data as soon as possible after obtaining it.
      d. Record and check the markup before enclosing concealed installations.
      e. Cross-reference record prints to corresponding photographic documentation.
   2. Content: Types of items requiring marking include, but are not limited to, the following:
      a. Dimensional changes to Drawings.
      b. Revisions to details shown on Drawings.
      c. Depths of foundations.
      d. Locations and depths of underground utilities.
      e. Revisions to routing of piping and conduits.
      f. Revisions to electrical circuitry.
      g. Actual equipment locations.
      h. Duct size and routing.
      i. Locations of concealed internal utilities.
      j. Changes made by Change Order or Construction Change Directive.
      k. Changes made following Architect's written orders.
      l. Details not on the original Contract Drawings.
      m. Field records for variable and concealed conditions.
      n. Record information on the Work that is shown only schematically.
   3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
   4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1.4 RECORD SPECIFICATIONS

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

B. Format: Submit record specifications as annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

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

C. Format: Submit Record Product Data as annotated PDF electronic file.
1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.3 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
   1. Inspect and discuss locations and other facilities required for instruction.
   2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, and facilities needed to avoid delays.
   3. Review required content of instruction.
   4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.4 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.5 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.

e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Systems and equipment operation manuals.
   c. Systems and equipment maintenance manuals.
   d. Product maintenance manuals.
   e. Project Record Documents.
   f. Identification systems.
   g. Warranties and bonds.
   h. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning.
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

1.6 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.7 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION 01 79 00

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Demolition and removal of selected site elements.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:
1. Section 01 77 00 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 31 10 00 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged.

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Provide and confirm list of such items as are visually observable or otherwise known as part of pre-demolition conference.
2. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review and finalize protection requirements.
5. Review procedures for noise control and dust control.
6. Review areas where existing construction is to remain and requires protection.
7. Review items to be salvaged and returned to Owner.

1.5 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
3. Shutoff, capping, or re-routing and continuation of utility services.

C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

D. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation. Provide PDF of key plan along with each set of electronic images.

1.6 **RIGHTS**

A. Ownership and copywrite privileges of photographic images belong to the Owner and the Architect. Under penalty of Law, the contractor shall not provide or transmit in any manner construction photographs to any entities except the Owner and the Architect without written authorization from the Architect.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy school buildings and site areas immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is possible that hazardous materials will be encountered in the Work. Reports detailing suspected hazardous materials are included in this project manual. The Contractor shall be responsible for the removal of these hazardous materials.
1. There are known hazardous materials in the building that will require abatement. Refer to abatement specification section and hazardous material survey contained within the project documents.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

D. On-site storage or sale of removed items or materials is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with operations of Owner's adjacent occupied buildings and site areas.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, with minimum size of 4 megapixels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.
   1. Record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
   2. General: Take photographs with maximum range depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted and will require replacement with acceptable images.
   3. Maintain key plan (electronic format or scanned PDF image) with each set of construction photographs that identifies each photographic location.
   4. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without **a**lteration, manipulation, editing, or modifications using image-editing software, except rotate images where necessary for correct up/down orientation.
      a. Date and Time: Include date and time in filename for each image.
      b. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
   5. Preconstruction Photographs: Before commencement of any work, take color, digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as required for the contractor's own purposes and as may be be additionally directed by the Architect.
      a. Flag excavation areas before taking construction photographs and be sure flag identifiers and site conditions within the flagged area are visible in the photographs.
      b. Take photographs to show existing conditions adjacent to property, driveways and roadways before starting the Work.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Arrange to shut off utilities with utility companies.
2. If services/systems are required to be removed, or relocated, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 PROTECTION

A. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."

C. Remove temporary barricades and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
5. Dispose of demolished items and materials promptly.[Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."]

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Salvaged Items; comply with the following:
1. Clean salvaged items.
2. Store items in a secure area until delivery to Owner.
3. Transport items to Owner's storage area designated by Owner.
4. Protect items from damage during transport and storage.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

E. Explosives: Use of explosives is not permitted.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Remove concrete and asphalt pavement as indicated.
1. Unless existing, full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.
3. Concrete and asphalt pavement may **not** be used as backfill within building footprint.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

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(513) 752-7973 (Fax)

Cleveland

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Cleveland, Ohio 44127
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(513) 752-7973 (Fax)

Florida

11982 Granite Woods Loop
Venice, Florida 34292
(513) 265-3299

Services

Phase I ESA's
Phase II Investigations
Asbestos
Lead-Based Paint
Industrial Hygiene
Indoor Air Quality/Mold
Radon
Safety
Training

Hazardous Materials Abatement Specification

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Appendix B Asbestos-Containing/Universal-Hazardous Waste Materials Inspection Report

SPECIAL CONDITIONS

I. All references to the Owner in these Specifications shall be interpreted as Winton Woods Local School District and any designated representatives.

II. The Contractor shall secure, pay for, and maintain in full force and effect until no longer necessary, all licenses, regulatory notifications, permits, and permissions required by Federal and State law, city ordinance, statute, or regulations and any rules or regulations of any service company that may assert control of any operation under this Contract. Copies of the above shall be filed prior to commencement of work.

III. The Contractor shall maintain a temporary office on-site which an authorized agent shall staff each workday. Copies of permits, Specifications marked up to date with all revisions and required regulations shall be kept in said office ready for use at all times. Said office shall have (at all times) a fully stocked first aid cabinet available for use for the Contractor's employees.

IV. In performing the Contract, the Contractor may utilize the existing electric and water service at the Owner's cost. Temporary electrical connections must be performed by a certified electrician approved by the Owner. The Contractor shall be responsible for the safe conveyance of water and electricity to the project areas and for any resulting damage from such conveyance. All sources of water and electricity conveyance shall be subject to the Owner's approval. NOTE: There may be areas in the building where the Contractor shall be required to supply portable generator(s) for an electrical source. Bidding Contractors are advised to walk the site and become familiar with conditions of each work area prior to submission of their bid.

V. The Contractor is required to staff the project with at least one (1) Ohio Environmental Protection Agency certified Asbestos Hazard Abatement Specialist to act in the supervisory capacity and as the OSHA competent person per 29 CFR 1926.1101. The Supervisor/competent person must be onsite at all times during the project. All other workers must be certified, at a minimum, as an Ohio Environmental Protection Agency Asbestos Worker. Certification cards must be onsite at all times.

VI. Prior to initiation of abatement activities, all workers must possess valid medical examination results from a licensed physician stating that the worker is capable of performing asbestos abatement, (i.e., wearing a respirator) and valid fit test results from within the past twelve (12) months for the respirator being worn by the worker.

VII. The Contractor is responsible for security of the work area and preventing unauthorized entry. The Contractor shall restrict access to Contractor personnel directly involved with the work, authorized Owner's Representatives, and regulatory inspectors legally entitled to inspect the work.

VIII. All of the Contractor's employees shall abide by Federal, State, and local laws and by the Owner's policies while on the premises.

IX. All of the Contractor's employees are restricted to those areas of the building and property directly included in the Project. Entry to all other areas is prohibited. Any employee whose conduct is judged unfit by the Owner and/or Consultant shall not be permitted to work on this project.

X. The Contractor shall not encumber the site with materials or equipment, and shall confine stockpiling of materials to the work area indicated. Storage of materials in public accesses and hallways shall not be permitted.

XI. No other Contractors shall be permitted to execute their work in the work areas until the asbestos abatement work is completed.

XII. Complete waste disposal documentation must be submitted to the Owner after landfill receipt. Documentation must show date/time that the waste left the job site to date/time waste was disposed of at the landfill identified on the EPA notification. Any layovers between leaving the job site (i.e., stored on the Contractor's property, etc.) and disposal date must be documented as well.

XIII. The Contractor is responsible for submitting a final report to the Consultant within thirty calendar days from the time of Substantial Completion. The contents of this final report shall contain all information required by the Consultant's "Final Documentation Audit" found in Appendix A.

XIV. Contractor must prove that all workers are U.S. citizens or that workers have a valid visa.

XV. In the event the Contractor utilizes non-English speaking workers, all required warning signs, Hazard Communications, etc., must be written in the language of the non-English speaking worker. At a minimum, one worker per work crew and/or work shift must speak English in order to communicate effectively with the Owner, Owner's Representatives, and/or Emergency Response personnel.

XVI. Winton Woods Local School District has retained the services of a Consultant to manage the project described herein. The Consultant shall represent the Owner in all phases of the work at the discretion of the Owner. The Contractor shall regard the Consultant's direction as authoritative and binding as provided herein, in matters including, but not limited to, the following:

a. Pre-construction submittals
b. Approval of work areas
c. Review of air and visual monitoring results
d. Completion of the various segments of the work
e. Final completion of the work
f. Post-project submittals

XVII. This specification is a part of the bid documents developed by SHP Leading Design. In the event of discrepancies, the most stringent will apply.

END OF SECTION

TECHNICAL ABATEMENT SPECIFICATIONS

PART 1 - WORK TO BE PERFORMED

1.1 DESCRIPTION OF WORK

The project involves the selective demolition and proper removal of hazardous materials throughout specified areas of Winton Woods Intermediate School, 825 Waycross Road, Cincinnati Ohio 45240. The structure is scheduled for demolition.

The scope of work includes:

- Removal of asbestos-containing cementitious pipe fitting insulation, floor tile, floor tile mastic, cove base mastic, ceiling tile mastic, and chalk board mastic (currently assumed asbestos-containing).

- Removal and disposal/recycling of all fluorescent light bulbs, fluorescent light ballast, exit sign batteries, and recovery of all CFC-containing equipment.

NOTE 1: Due to the destructive nature of identifying the presence of hidden suspect asbestos-containing materials (e.g., chalk board mastic, vermiculite, floor vapor barriers etc.,) these materials were not sampled. After the building has been vacated, sampling of these materials <u>may</u> be performed, and an addendum will be issued to address all findings that pertain to the renovation.

NOTE 2: The drywall joint compound throughout the building contains >1% asbestos (the composite of the drywall and drywall joint compound contains <1% asbestos). The Contractor must comply with Occupational Safety and Health Administration regulation 29 CFR 1926.1101 should the drywall/joint compound require removal.

NOTE 3: The roof drain insulation and window caulking throughout the building contains <1% asbestos. The Contractor must comply with Occupational Safety and Health Administration regulation 29 CFR 1926.1101 should these materials require removal.

NOTE 4: This specification encompasses all materials that may potentially be removed prior to renovation. The specific scope of work will be defined by SHP Leading Design.

NOTE 5: All Bidders are solely and totally responsible for verifying and quantifying the actual amount of materials listed.

1.2 OWNER'S REPRESENTATIVE

This project will be coordinated through Ms. Allison McKenzie, SHP Lead Design, 312 Plum Street, Suite 700, Cincinnati, Ohio 45202, 513-381-2112 and Mr. George Beaudion, m.a.c. Paran Consulting Services (513) 752-9111.

1.3 PROJECT TIME SCHEDULE

The project work shall be performed as shown below:

<u>Activity</u>	<u>Effective Date(s)</u>
Pre-bid meeting (@ project site)	To be Determined

Sealed bid due	To be Determined
Award of project	See Milestone Schedule
Work start/completion date	See Milestone Schedule

PART 2 - GENERAL

2.1 SCOPE AND CONTRACTOR RESPONSIBILITIES

2.1.1 Work Specified - The Contractor shall furnish all labor, materials, employee training, services, insurance, bonds, regulatory notifications and/or permits, and equipment required to perform this Work in accordance with requirements of this Specification. The Contractor shall furnish all said items to complete removal and decontamination of all asbestos-containing materials specified and as defined.

2.1.2 Contractor Responsibilities - In addition to the removal of asbestos-containing materials, the Contractor is responsible for the following: 1) The Contractor shall take all reasonable precautions necessary to protect persons and property from injury or damage during the performance of this contract; 2) The Contractor shall be responsible for any injury to himself, their employees, as well as for any damage to personal and Winton Woods Local School District property that occurs during the performance of this contract that is caused by their employee's fault or negligence; 3) The Contractor shall be responsible for protection of all electrical and/or fire alarm systems during abatement activities; 4) The Contractor shall be responsible for all demolition (and disposal) required, including but not limited to: hard plaster, drywall, suspended ceilings, air handler units, cabinets, carpet, etc., in order facilitating the removal process of all specified asbestos-containing materials; 5) The Contractor shall be responsible for disposal of all non asbestos-contaminated building materials removed in order to facilitate asbestos abatement; 6) The Contractor shall be responsible for removal and disposal of all carpet (that has asbestos-containing floor tile beneath) located throughout the building; and 7) The Contractor shall be responsible for and shall maintain personal liability and property damage insurance having coverage for a limit as required by the laws of the State of Ohio.

2.2 INDEMNIFICATION

2.2.1 Patent Indemnification - The Contractor shall pay all license fees and royalties and assume all cost incidents to the use in the performance of work or the incorporation in the work of any invention, design, process, product, or device which is the subject of patent rights held by others. The Contractor shall indemnify and hold harmless the Owner, Consultant, and anyone directly or indirectly employed by them from and against all claims, damages, losses and expenses, including attorneys' fees and court and arbitration cost arising out of any infringement of patent rights incident to the use in performance of the work of any invention, design, process, product or device specified or not specified in the Contract documents, and shall defend all such claims in connection with any alleged infringement of such rights.

2.3 TERMINOLOGY AND DEFINITIONS

2.3.1 Abatement - Procedures to control fiber release from asbestos-containing materials, i.e., removal, encapsulation, or enclosure.

2.3.2 Air Lock - A system for permitting ingress or egress without permitting air movement between a contaminated area or an uncontaminated area, typically consisting of two contained doorways at least 6 feet (2 meters) apart.

2.3.3 Air Monitoring - The process of measuring the fiber content of a specific volume of air in a stated period of time. Phase contrast microscopy in accordance with NIOSH Method No. 7400 is the prescribed method of sampling and analysis.

2.3.4 Air Sampling Technician - A person trained and experienced in air sampling techniques and schemes that performs air sampling under the direction of the Environmental Project Manager or C.I.H.

2.3.5 Amended Water - Water to which a surfactant has been added.

2.3.6 Asbestos Hazard Emergency Response Act (AHERA) - Congressional Act which requires local education agencies to identify friable and non-friable asbestos-containing building materials (ACBM) in public and private elementary and secondary schools; submit management plans to the Governor of their state; implement management plans in a timely manner; and maintain complete records of any action involving the disturbance of ACBM.

2.3.7 Authorized Visitor - The building owner or their representatives, air sampling technician, asbestos project manager, Consultant, or a representative of any regulatory or other agency having jurisdiction over the project.

2.3.8 Barrier - Plastic sheeting and/or other materials used along with the floors, ceilings, and walls of a structure to form an isolated Work environment that separates the contaminated work area from the uncontaminated area.

2.3.9 Bridging Encapsulant - A liquid designed to form a tough membrane over the surface of asbestos-containing materials.

2.3.10 Building Owner - Winton Woods Local School District or their authorized representative(s).

2.3.11 Clean Room - An uncontaminated area or room that is part of the workers' decontamination enclosure system, with provisions for storage of workers' street clothes and protective equipment.

2.3.12 Competent Person - A Contractor's employee (typically the supervisor or superintendent) by virtue of their education and experience who is capable of operating an asbestos hazard abatement project in accordance with current EPA, OSHA, and NIOSH regulations, and standard Work practices established for asbestos removal. Duties of the competent person are as defined in 29 CFR 1926.1101.

2.3.13 Consultant - A Certified Industrial Hygienist (C.I.H.), the designated Consultant, or an Industrial Hygiene Technician under the supervision of the C.I.H. or the Consultant.

2.3.14 Contaminated - Containing or coated with asbestos.

2.3.15 Curtained Doorway - A device to allow ingress or egress from one room to another while minimizing air movement between the rooms, typically constructed by placing two overlapping sheets of plastic over an existing or temporarily formed doorway, securing the vertical edge of one sheet along one vertical side of the doorway, and securing the vertical edge of the other sheet along the opposite vertical side of the doorway. Two curtained doorways spaced a minimum of 6 feet (2 meters) apart form an air lock.

2.3.16 Decontamination Enclosure System - A series of connected rooms, with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. A decontamination enclosure system always contains at least one airlock.

2.3.17 Encapsulant - A liquid material that can be applied to asbestos-containing materials or cleaned substrates following the removal of asbestos-containing materials to control the possible release of residual asbestos fibers from the material by creating a membrane over the surface.

2.3.18 Encapsulation - All herein specified procedures necessary to coat asbestos-containing materials with a penetrating or bridging encapsulant to control the possible release of asbestos fibers into the ambient air.

2.3.19 Environmental Project Manager - An individual qualified by virtue of experience, designated as the Owner's representative; and responsible for supervising the on-site Consultant and ensuring compliance with the Project Specifications.

2.3.20 Equipment Decontamination Enclosure System - A decontamination enclosure system for materials and equipment, typically consisting of a designated area of the work area, a washroom, a holding area, and an uncontaminated area.

2.3.21 Equipment Room - A contaminated area or room that is part of the worker decontamination enclosure system, with provisions for storage of contaminated clothing and equipment.

2.3.22 Facility Component - Any pipe, duct, boiler, tank, fan, engines, or furnace at or in a facility, or any structural member of a facility.

2.3.23 Fixed Object - A piece of equipment or furniture in the work area that cannot be removed from the work area.

2.3.24 Glovebag Technique - A method with limited applications for removing small amounts of asbestos-containing material from HVAC ducts, piping runs, valves, joints, elbows, and other uneven surfaces in an uncontaminated (plasticized) work area. The glovebag assembly is a manufactured or fabricated device consisting of a glovebag (typically constructed of 6-mil transparent plastic); two inward-projecting, long-sleeve, rubber gloves; one inward-projecting water wand sleeve; an internal tool pouch; and an attached, labeled receptacle for asbestos waste. The glovebag is constructed and installed in such a manner that it surrounds the object or area to be decontaminated and contains all asbestos fibers released during the removal process. All workers who are permitted to use the glovebag technique must be highly trained, experienced, and skilled in this method.

2.3.25 HEPA Filter - A highly-efficiency particulate air (absolute) filter capable of trapping and retaining 99.97 percent of asbestos fibers greater than 0.3 micrometer in length.

2.3.26 HEPA Vacuum - High-efficiency particulate air (absolute) filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers. Filters should be 99.97 percent efficient for retaining 0.3-micrometer particles or larger.

2.3.27 Holding Area - A chamber between the washroom and an uncontaminated area in the equipment decontamination enclosure system. The holding area comprises an air lock.

2.3.28 Movable Object - A piece of equipment or furniture in the work area that can be removed from the work area.

2.3.29 Negative Pressure Ventilation System - A local exhaust system capable of maintaining a detectable pressure differential across containment barriers relative to adjacent unsealed areas.

2.3.30 NESHAPS - The National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61).

2.3.31 NIOSH - The National Institute for Occupational Safety and Health.

2.3.32 OSHA - Occupational Safety and Health Administration.

2.3.33 Penetrating Encapsulant - A liquid designed to saturate the material, thereby binding asbestos fibers to one another and to other substances in the material.

2.3.34 Polyethylene (poly) - 6-mil plastic sheeting used to cover floors, walls, etc., as herein specified.

2.3.35 Removal - All herein specified procedures necessary to strip or clean up asbestos-containing materials from designated areas and to dispose of these materials at an acceptable disposal site.

2.3.36 Shower Room - A room between the clean room and the equipment room in the worker decontamination enclosure system, with hot, and cold or warm running water and suitably arranged for complete showering during decontamination. The shower room comprises an airlock between contaminated and clean areas.

2.3.37 Staging Area - Either the holding area or an area near the waste-transfer airlock where containerized asbestos waste has been placed prior to removal from the work area.

2.3.38 Stripping - All herein specified procedures necessary to remove asbestos-containing materials or asbestos-contaminated materials from their substrate or from any component of the facility.

2.3.39 Substrate - The underlying surface or material (piping, duct, boilers, tanks, chase floors, etc.) to which asbestos-containing material has been applied.

2.3.40 Surfactant - A chemical wetting agent added to water to improve penetration.

2.3.41 Thermal System Insulation - Insulation used to prevent heat loss from pipes, boilers, tanks, breeching, heat exchangers, etc.

2.3.42 Washroom - A room between the work area and the holding area in the equipment decontamination enclosure system. A washroom comprises an air lock.

2.3.43 Wet Cleaning - The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools that have been dampened with water, and then disposing of these cleaning tools as asbestos-contaminated waste.

2.3.44 Work Area - Designated rooms, spaces, or areas of the project in which asbestos abatement actions are to be undertaken or which may be contaminated as a result of such abatement actions. A contained work area is one that has been sealed, plasticized, and equipped with a decontamination enclosure system. An isolated work area is a controlled-access work area that has been isolated by plastic curtains and in which the openings to the outside are sealed with plastic sheeting. An isolated work area is not an airtight containment area and is not equipped with a decontamination enclosure system.

2.3.45 Worker Decontamination Enclosure System - A decontamination enclosure system for workers, typically consisting of a clean room, a shower room, and an equipment room.

2.4 APPLICABLE REFERENCE DOCUMENTS

The current issue of each document shall govern. If there is a conflict among requirements or with these Specifications, the more stringent requirement shall apply.

2.4.1 Regulations - Compliance is required in strict accordance with applicable Federal, State, municipal, and local regulations.

2.4.1.1 Title 29, Code of Federal Regulations, Section 1910.1001, Occupational Safety and Health Administration (OSHA), U.S. Department of Labor.

2.4.1.2 Title 29, Code of Federal Regulations Section 1926.1101, Occupational Safety and Health Administration (OSHA), U.S. Department of Labor.

2.4.1.3 Title 29, Code of Federal Regulations Section 1926.139, General Industry Standard for Respiratory Protection.

2.4.1.4 Title 29, Code of Federal Regulations Section 1926.59, Construction Industry Standard for Hazard Communication.

2.4.1.5 Title 29, Code of Federal Regulations Section 1910.1200, General Industry Standard for Hazard Communication.

2.4.1.6 Title 29, Section 1910.1000, Occupational Safety and Health Standards.

2.4.1.7 Title 40, Code of Federal Regulations, Part 61, Subpart A and M, National Emissions Standards for Hazardous Air Pollutants, U.S. Environmental Protection Agency (EPA).

2.4.1.8 Title 40, Code of Federal Regulations, Part 763, Asbestos-Containing Materials in Schools; Final Rule and Notice, U.S. Environmental Protection Agency (EPA).

2.4.1.9 Title 40, Code of Federal Regulations, Part 761, Polychlorinated Biphenyls (PCB's).

2.4.1.10 Ohio Revised Code, Chapter 3745-20 and 3710.

2.4.1.11 Title 49, Code of Federal Regulations, Hazardous Materials Transportation Regulations, U.S. Department of Transportation (DOT).

2.4.2 Codes and Standards

2.4.2.1 ANSI - American National Standards Institute, ANSI Z 9.2, Fundamentals Governing the Design and Operation of Local Exhaust Systems.

2.4.2.2 NEC - National Electric Code. Any Work involving electrical equipment in a facility or wet environments shall be performed in strict accordance with the National Electric Code.

2.5 AIR MONITORING

2.5.1 Asbestos Exposure Monitoring Schedule and Sampling Strategy- At a minimum, the Contractor's air monitoring schedule and sampling strategy for asbestos-related work shall be conducted as follows:

ASBESTOS EXPOSURE MONITORING SCHEDULE

Phase of Abatement Project	When to Sample	Type of Sample	Minimum # of Samples	Location
PREPARATION	Each day of operation	Personal	1	Inside work area
		Excursion	1	Inside work area

REMOVAL	Each day of operation	Personal	1	Inside work area
		Excursion	1	Inside work area
DECONTAMINATION	Each day of operation	Personal	1	Inside work area
		Excursion	1	Inside work area

NOTE: At a minimum, one out of four workers involved in asbestos hazard abatement activities shall be monitored during all preparation, gross removal, decontamination, and load-out phases of this Project. Short-term excursion samples shall also be collected per activity and/or at the request of the Consultant.

2.5.2 Methods of Collection and Analysis

2.5.2.1 All air monitoring shall be conducted in accordance with 29 CFR 1926.1101. The sampling period shall be 7 to 8 hours, except on abbreviated work shifts. The flow rate for the sampling pump shall be 0.5 to 2.5 liters/minute. Sampling pumps shall be calibrated daily to ensure proper flow-rates.

2.5.2.2 All pertinent personal exposure sampling data shall be completed in full on a daily basis with all required entries and calculations.

2.5.2.3 All samples collected by the Contractor, or their representative, shall be submitted at the end of each work shift for analysis. Completed data sheets must be submitted to the laboratory along with each day's filter samples. Sampling results shall be reported to the Contractor within twenty-four hours of their collection.

2.5.2.4 The minimum number of employees and areas to monitor indicated shall not be interpreted as the total number of samples to be collected and analyzed each day. Multiple personal or area samples may have to be collected during the 7 to 8 hour work shift to accurately characterize a worker's exposure level. The number of samples collected shall depend on the degree of airborne contamination in the work area and the effectiveness of work practices and engineering controls. Overloaded filter samples or filter holder cassettes containing loose particulate matter are unacceptable. The air samples must be properly collected and representative of actual concentrations in each work area.

2.6 PERSONNEL PROTECTION

2.6.1 Worker Instruction - Prior to commencement of work, the workers shall be instructed and made knowledgeable about all aspects of the written respiratory protection program, hazards of asbestos exposure, decontamination procedures, entry and exit procedures, protective clothing requirements, safe work practices, and shall have received the OSHA required medical examination, per 29 CFR 1926.1101.

2.6.2 Respiratory Equipment - Workers shall be provided with personally issued and marked respiratory protection equipment approved by NIOSH and suitable for the asbestos exposure level in the work area according to OSHA Standard 29 CFR 1926.1101. At a minimum, all workers performing abatement activities in total containment work areas shall wear powered air purifying respirators (PAPR'S) equipped with NIOSH approved HEPA filter cartridges suitable for asbestos exposure. Half face negative pressure respirators shall be permitted for all final cleaning activities, modified negative pressure containments, and during negative pressure glove bag removal activities. Sufficient filter cartridges for replacement shall be provide as required by the worker, applicable regulations, or as bound into this specification.

2.6.3 Protective Clothing - Workers shall be provided with sufficient sets of protective full-body clothing per OSHA Standard 1926.1101. Such clothing shall consist of full-body coveralls and headgear. Eye protection and hard hats shall be provided as required. Non-disposable protective clothing

and footwear shall be left in the contaminated equipment room until the end of the asbestos abatement work, at which time such items shall be disposed of as asbestos waste, or shall be thoroughly cleaned of all asbestos or asbestos-containing material. Note: Workers shall be permitted to wear only rubber boots in contained work areas; no other type of footwear shall be permitted.

2.6.4 Visitor Protection - Authorized visitors shall be provided with suitable respirators with new filters or cartridges and protective clothing, headgear, eye protection, and footwear whenever they are required to enter the work area, to a maximum of three (3) sets per day. Authorized visitors for this project include regulatory agencies, Consultant, and the Owner's Representatives who are certified to enter a regulated work area.

2.6.5 Protection Procedures - The Contractor shall provide and post, in the equipment room and the clean room, the decontamination and work procedures to be followed by workers.

2.6.6 Worker Protection Procedures

2.6.6.1 Each worker and authorized visitor shall, upon entering the job site: remove street clothes in the clean change room and put on a respirator with new filters and clean protective clothing before entering the equipment room or the work area; except workers that intend to re-wear contaminated protective clothing stored in the equipment room (entering the equipment room wearing only respirator).

2.6.6.2 Each worker and authorized visitor shall, each time they leave the work area: remove gross contamination from clothing before leaving the work area; proceed to the equipment room and remove all clothing except respirators; still wearing the respirator, proceed naked to the shower; clean the outside of the respirator with soap and water while showering; remove the respirator; thoroughly shampoo and wash; if the filters require replacement, remove filters, wet them, and dispose of them in the container provided for that purpose; and wash and rinse the inside of the respirator.

2.6.6.3 Following showering and drying off, each worker and authorized visitor shall proceed directly to the clean change room for re-dressing into street clothes, or into a clean disposable suit if the exit is for a short break period and re-entry is shortly expected.

2.6.6.4 Contaminated work footwear shall be stored in the equipment room when not in use in the work area. After the asbestos abatement process is completed, footwear shall be disposed of as contaminated waste or cleaned thoroughly inside and out with soap and water before being removed from the work area or from the equipment and access area. Contaminated protective clothing shall be stored in the equipment room for reuse or placed in receptacles for disposal with other asbestos-contaminated materials.

2.6.6.5 Workers shall not eat, drink, smoke, chew gum, or chew tobacco at the work site except in the established clean room or outside the building. NOTE: No smoking is permitted inside any areas of the building.

2.6.6.6 Workers shall be fully protected with respirators and protective clothing immediately prior to the first disturbance of asbestos-containing or contaminated material, and until final cleanup is completed and final clearance given.

2.7 EQUIPMENT REMOVAL PROCEDURES

2.7.1 Cleaning - Clean external surfaces of contaminated containers and equipment thoroughly by wet mopping, or using a HEPA-filtered vacuum before moving such items into the decontamination

enclosure system washroom for final cleaning and removal to uncontaminated areas. Ensure that personnel do not leave work areas through the equipment decontamination enclosure system.

2.8 EMERGENCY PRECAUTIONS

2.8.1 Prepare a written contingency plan for emergencies including fire, accident, power failure, pressure differential system failure, supplied air system failure (if applicable), or any other event that may require modification or abridgment of decontamination or work area isolation procedures. Include in the plan specific procedures for decontamination or work area isolation.

2.8.2 The Contractor shall be responsible for providing a minimum of one fire extinguisher, rated not less than 2A, for each three thousand square feet of containment area in accordance with 29 CFR 1926.150. Travel distance from any point inside the work area to the nearest fire extinguisher shall not exceed seventy-five feet. NOTE: 1) Substitution of a fire extinguisher with a half-inch garden hose not exceeding seventy-five feet in length shall be permitted provided the number of hoses is equivalent to the required number of fire extinguishers; 2) Hose(s) attached to the decontamination unit shall not serve as a fire extinguisher; and 3) All contained work areas shall be marked (with high visibility paint) on the lower sections of the walls to aid in escape in the event of a fire.

2.8.3 Employees shall be trained in evacuation procedures in the event of work area emergencies.

2.8.3.1 For non-life-threatening situations, employees injured or otherwise incapacitated shall decontaminate themselves following normal procedures with assistance from fellow workers, if necessary, before exiting the work area to obtain proper medical treatment.

2.8.3.2 For life-threatening injury, worker decontamination shall take least priority after measures to stabilize the injured worker, remove him from the work area, and secure proper medical treatment.

2.8.4 Before the Contractor starts abatement activities, the local police and fire departments should be informed of the danger of entering a contaminated work area. The Contractor shall make every effort to help these agencies form plans of action should their personnel need to enter contaminated work areas, and to assist during emergencies.

2.8.5 Telephone numbers of all emergency response personnel shall be prominently posted in the clean/change room outside the worker decontamination enclosure system along with location of the nearest telephone.

2.8.6 All accidents involving personal injury, property loss, or "near miss" incidents shall be immediately reported to the Owner and/or their representative(s).

2.9 SITE SECURITY

2.9.1 The Contractor shall post warning signs at designated entrances to each work area as required by 29 CFR 1926.1101.

2.9.2 The work area is to be restricted to authorized, trained, and protected personnel only. These may include the Contractor's employees, employees of Subcontractors, Owner's employees and representatives, State and local inspectors, and any other designated individuals.

2.9.3 Entry into the work area by unauthorized individuals shall be reported immediately to the Owner's representative by the Contractor.

2.9.4 The Contractor shall have control of site security of the work area during abatement activities in order to protect work efforts and equipment. The Owner shall maintain building security of the facility after work hours.

2.9.5 Parking must be approved by Winton Woods Local School District.

PART 3 - MATERIALS AND EQUIPMENT

3.1 MATERIALS

3.1.1 Material Delivery - All materials shall be delivered clean, in proper working order, and shall bear the name of the manufacturer and brand. Safety Data Sheets shall be required for all materials brought on-site by the Contractor.

3.1.1.1 All materials subject to damage shall be stored off the ground, away from wet or damp surfaces, and under sufficient cover to prevent damage or contamination.

3.1.1.2 Damaged or deteriorating materials shall not be used and shall be removed from the premises. Material that becomes contaminated with asbestos shall be disposed of in accordance with this Specification.

3.1.2 Polyethylene - Polyethylene for all uses, shall be a minimum of 6-mil thick. All polyethylene shall be sized in appropriate lengths and widths to minimize the frequency of joints.

3.1.2.1 Plastic sheeting used for worker decontamination enclosure systems shall be black in color.

3.1.3 Tape - Must be capable of sealing joints of adjacent plastic sheets, capable of attaching plastic sheets to finished or unfinished surfaces of dissimilar materials, and capable of adhering under dry and wet conditions, including use of amended water.

3.1.4 Surfactant - A surfactant shall consist of 50 percent polyoxyethylene ether and 50 percent polyoxyethylene ester, or equivalent, and shall be mixed with water to provide a concentration of 1 ounce surfactant to 5 gallons of water, or according to manufacturer's Specifications.

3.1.5 Impermeable Containers - Must be suitable for receiving and retaining any asbestos-containing and/or contaminated materials. Metal or fiber drums with tight-fitting lids are required for all asbestos-containing wastes, i.e., metal lath, wire, metal jackets, etc. Plastic bags, 6-mil thick, are acceptable for friable asbestos, fiberglass insulation without metal components that could tear the bags. All asbestos-containing waste shall be labeled in accordance with 29 CFR 1926.1101, 49 CFR Parts 171 and 172 and 40 CFR Part 61, Subpart M.

3.1.6 Encapsulants - Encapsulating sealants shall be bridging or penetrating sealants such as Cafco "Bond Seal," or an approved equivalent.

3.1.6.1 Encapsulants selected for use by the Contractor shall be one of those demonstrating effective performance under the tests conducted by Battelle Laboratories for EPA.

3.1.6.2 The encapsulant shall not add any toxic substances to the asbestos-containing material and should not break down under direct flame impingement to release any toxic gases or an undue amount of smoke.

3.1.6.3 The encapsulant shall be capable of adhering to the substrate surface.

3.1.6.4 The encapsulant shall be applicable with minimum effort and skill.

3.1.6.5 The encapsulant shall have impact resistance, flexibility, and resistance to penetration in withstanding physical contact.

3.1.6.6 The encapsulant shall be water insoluble when cured.

3.1.6.7 The encapsulant shall be nontoxic and free of toxic fumes during application.

3.1.6.8 The encapsulant shall have sufficient aging characteristics to withstand normal atmospheric changes for a minimum of 6 years.

3.1.7 Warning Labels and Signs - As required by 29 CFR 1926.1101.

3.1.8 Glovebags - Two types of glovebags shall be considered suitable for this Project.

3.1.8.1 Polyethylene glovebag - This special prefabricated device is designed for the controlled removal of asbestos-containing materials from pipes and other nonplanar structures and consists of a minimum 7-mil, clear, polyethylene plastic bag (approximately 50 in. wide by 64 in. long) with integral impermeable arms and latex gloves. Each bag shall be equipped with internal attached tool pouch and entry port for insertion of wetting tube and/or HEPA-vacuum hose nozzle.

3.1.8.2 Polyvinyl chloride glovebag - This prefabricated device is designed for the controlled removal of asbestos-containing materials from pipes or other nonplanar surfaces and consists of a minimum 10-mil, clear, polyvinyl chloride (PVC) bag with integral 10-mil-thick PVC gloves, elasticized valve/port, and tool pouch. Each bag shall be equipped with a reversible, double-throw zipper on top to facilitate installation on pipes and progressive movement along the pipes. Reusable nylon straps (1 inch thick) with metal-tightening buckles shall be used for sealing the ends of the bags around pipe and/or insulation. Specially designed bags shall be used around "T" fittings and horizontal and vertical pipe configurations. PVC-zippered expansion strips shall be used to enclose large diameter pipes.

3.1.9 Plexiglas - The Contractor shall install Plexiglas in doorways or openings adjacent to the work area to enable observations by the Owner and their representatives without entering the work area. The Plexiglas partitions shall be a minimum size of 12”x12”. The number of partitions shall be based on availability and size of the area and as requested by the Owner and their representatives.

3.1.10 Other Materials - The Contractor shall provide all other materials, such as lumber, nails, and hardware, that may be required to construct and dismantle the decontamination units and the barriers that isolate the work area.

3.2 TOOLS AND EQUIPMENT

3.2.1 The Contractor shall provide suitable tools and equipment for all phases of work for this Project.

3.2.1.1 Air movement equipment - High efficiency particulate air (absolute) filtration equipment in compliance with ANSI Z 9.2, Local Exhaust Ventilation. No air movement system or air equipment shall discharge asbestos fibers outside the work area into the building.

3.2.1.2 Each HEPA filter shall be individually tested and certified by the manufacturer to have an efficiency of not less than 99.97 percent when challenged with 0.3-micron dioctylphthalate (DOP) particles. Testing shall be in accordance with Military Standard Number 282 and Army Instruction Manual 136-300-175A. Each filter shall bear a UL586 label to indicate the ability to perform under special conditions. Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of test air flow.

3.2.1.3 A negative air pressure differential shall be established in the work area by means of mechanical exhaust equipment in order to keep airborne fibers confined to the work area, decrease humidity and temperature, reduce fiber levels in the work area, and achieve acceptable final air monitoring results. The mechanical equipment shall exhaust through a HEPA filter to the outside of the building. The equipment shall remain in operation twenty-four hours a day until decontamination of the work area and final air sampling and analysis is completed.

3.2.1.4 Backup air filtration devices shall be available at the site in the event of unit failure and need for substitution.

3.2.2 Airless Sprayer - An airless sprayer shall be used for the application of amended water and encapsulants.

3.2.3 Scaffolding and Ladders - Scaffolding and ladders shall be used as required to accomplish work specified in Part 1 and shall meet or exceed all applicable OSHA requirements and safety regulations.

3.2.4 Vacuums - All vacuums utilized to clean up asbestos-containing materials in the work area shall be equipped with HEPA filters. NOTE: All HEPA equipped vacuums used on this project shall be thoroughly decontaminated prior to being brought on site.

3.2.5 Miscellaneous Tools and Equipment - The Contractor shall provide all other tools suitable for the stripping, removal, and encapsulation of asbestos-containing materials. These tools include, but are not limited to, scrapers, wire cutters, brushes, sprayers, sponges, utility knives, flexible wire saws, shovels, and brooms.

3.2.6 Use of Owner's Tools and Equipment - No tools or equipment of the Owner shall be used by the Contractor unless permission in writing is granted by the Owner's representatives.

3.3 WATER SERVICE

3.3.1 Temporary Water Service Connection - All connections to the Owner's water system shall include backflow protection. Valves shall be temperature and pressure rated for operation of the temperatures and pressures encountered. After completion of use, all connections and fittings shall remain in place for use by the Owner.

3.3.2 Water Hoses - Employ heavy duty, abrasion resistant hoses with a pressure rating greater than the maximum pressure of the water distribution system to provide water into each work area. Provide fittings as required to allow for connections. NOTE: Any leaking hoses shall be immediately repaired and/or removed from the project.

3.3.3 Water Heater - If hot water is not available at the building, provide at least one (1) UL rated 40-gallon electric hot water heater to supply hot water to the decontamination unit. Provide with relief valve compatible with water heater operation; pipe relief valve down to drip pan on floor with type L copper. Wiring of the hot water heater shall be in compliance with NEMA, NECA, and UL standards.

3.4 ELECTRICAL SERVICE

3.4.1 General - Comply with applicable NEMA, NECA, and UL standards and governing regulations for materials and layout of temporary electrical service. NOTE: All modifications and/or connections made to the buildings' electrical system shall be performed by a certified electrician at the consent of the Owner.

3.4.2 Lockout - Lockout all existing power to or through the work area as described below. Unless specifically noted otherwise, existing power and lighting circuits to the work area are not to be used. All power and lighting to the work area and decontamination facilities are to be provided from temporary electrical panel described in article 3.4.3.

3.4.2.1 Lockout power to circuits running through work area where feasible by switching off all breakers servicing these circuits. Label breakers with tape over breaker with notation "DANGER - circuit being worked on." Sign and date danger tag. Lock panel and have keys under the sole control of electrician and Supervisor. If circuits cannot be shut down for any reason, label energized power and lighting circuits, and equipment with tags reading "DANGER - Live Electric, Electrocution Hazard.

3.4.3 Electrical Distribution System - Temporary electric panels equipped with ground fault circuit interrupters (GFCI's) shall be installed outside of the enclosed work areas with sufficient circuits to support all AFD's, lighting, electric tools, and air sampling equipment inside and outside of the enclosed work area. All temporary electrical power shall comply with the requirements of the National Electric Code for Wet Environments. Provide only UF non-metallic sheathed cable.

3.4.4 Electric Tools - Electrical tools and equipment shall meet all applicable codes and regulations. GFCI's shall be used at all times for electrical equipment.

3.4.5 Electrical Power Cords - Use only grounded extension cords; use "hard service" cords where exposed to abrasion and traffic. Use single lengths or use waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas of work.

3.4.6 Lamps and Light Fixtures - Provide general service incandescent or halogen lamps of wattage indicated or required for adequate illumination. Protect lamps with guard cages or tempered glass enclosures. Provide lighting fixtures suitable for wet environments.

3.5 TEMPORARY LIGHTING

3.5.1 Where natural lighting does not meet the required light level, provide one (1) 200-watt halogen light per every 500 square feet of floor area. In stairways and at ladder runs, provide one 100-watt incandescent lamp per story, located so as to illuminate each landing and flight. Provide sufficient temporary lighting to ensure proper workmanship everywhere, by combined use of daylight, general lighting, and portable plug-in task lighting.

3.6 FIRE EXTINGUISHERS

3.6.1 Provide Type "A" fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical or grease-oil-flammable liquid fires. In other locations, provide type "ABC" dry chemical extinguishers, or a combination of several extinguishers of NFPA recommended types for the exposures in each case.

PART 4 - EXECUTION

4.1 SEQUENCE OF EXECUTION

4.1.1 Negative Pressure Enclosure (cementitious pipe fitting insulation) -

4.1.1.1 Shut down and lock out electric power to all work areas where applicable. Provide temporary power and lighting and ensure the safe installation of temporary power services and equipment, as specified in applicable electrical code requirements. Provide ground-fault interrupt circuits as

a power source for all electrical equipment. All modifications to the building's electrical system shall be performed by a certified electrician at the consent of the Owner. The power service shall not violate the integrity of the area isolation. Auxiliary lighting used in the work area shall be moisture proof.

4.1.1.2 Seal all other openings from the work area, including but not limited to: doorways; windows; diffusers, return and relief grilles, and any other HVAC openings; and any other penetrations, with two layers of 6-mil polyethylene sheeting sealed with tape. The work areas shall be demarcated with construction barrier tape and caution signs.

4.1.1.3 Introduce scaffolding and other large equipment that will not pass through the work area isolation structure.

4.1.1.4 Where the work area terminates either in a corridor which is in use or adjacent to other occupied areas of the building, neither of which is separated from the work area by existing building construction (e.g., doors, walls, etc.), the Contractor shall install two 6 mil polyethylene barriers, each airtight and at least 3 feet apart. In addition to these plastic barriers, the Contractor shall construct temporary framed partition(s) consisting of full height wood studs and 1/2" plywood to prohibit access to the contaminated work area, except through the approved decontamination system(s). If the barriers will abut asbestos-containing material, then the barriers shall be installed after installation of the work area isolation structure.

4.1.1.5 Cover floor and wall surfaces with two layers of 6-mil polyethylene sheeting sealed with tape Apply anti-slip materials to steps (if applicable) so that the polyethylene film can be firmly anchored to avoid shifting layers of sheeting. Install floor polyethylene a minimum of 10" up the walls and overlap with the wall sheeting. Where appropriate, provide support for the wall polyethylene to reduce tension on tape and to ensure that the sheeting will not fall during the course of the work. Care shall be exercised to provide an air and watertight seal of the floor to wall sheeting joints, and at openings such as doors and windows. NOTE: The Contractor shall not be permitted to substitute the two layers of 6-mil poly sheeting with one layer of 10-mil poly sheeting. The polyethylene sheeting shall be installed as follows:

- floors - two (2) layers of 6-mil
- walls - two (2) layers of 6-mil

4.1.1.6 Install Plexiglas viewing windows where feasible as directed by the Consultant.

4.1.1.7 Install HEPA-filtered air filtration devices (AFD) into the work area and vent exhaust ducts through openings to the outside atmosphere. The following formula shall be used to calculate the number of AFD's required:

$$\#\text{AFD's} = \frac{\text{length x width x height of work area}}{\text{15 minutes x AFD capacity (in CFM)}}$$

Accomplish the negative pressure by exhausting a sufficient number of HEPA filtered fan units from the work area to the outside building air using disposable flex duct in lengths no greater than 50 feet (if exhaust locations exceed 50 feet, "booster" or additional in-line units may be required). AFD exhausting onto pedestrian walkways is prohibited.

Continuously maintain the work area at an air pressure that is lower than that of any surrounding outside area (negative pressure). This negative pressure, when measured across any physical or critical barrier, must equal, or exceed a static pressure of -0.02 inches of water. Provide a manometer with a dial or strip recorder to measure and record the pressure differential across the barrier at all times. The negative pressure shall be maintained for the duration of the project until clearance air sampling results is obtained meeting the clearance criteria. NOTE: Should negative pressure drop below -0.02 inches of water, the Contractor shall immediately stop all work in the

contained area(s) until the required pressure is achieved.

4.1.1.8 Establish a contiguous three chamber decontamination unit in accordance with OSHA 29 CFR 1926.1101 and Article 4.2 with functional shower.

4.1.1.9 Pre clean fixed and immovable objects and/or contaminated furniture and materials within the work area using HEPA-equipped vacuums and/or wet cleaning methods as appropriate, and enclose with polyethylene film and seal with tape.

4.1.1.10 Pre-clean contaminated furniture and materials within the work area using HEPA-equipped vacuums and/or wet cleaning methods as appropriate. Remove any decontaminated furniture and materials from the work area and store or discard as directed by the Owner. NOTE: Stationary items in the work area(s) may be inspected by the on-site Consultant prior to allowing the Contractor to seal them with polyethylene film and tape.

4.1.2 Regulated Work Area Removal (glove bag removal) -

4.1.2.1 Place OSHA approved warning signs and barrier tape, demarcating area from unauthorized entrance.

4.1.2.2 Place one layer of 6-mil polyethylene sheeting on floor and/or floor to act as a drop cloth to collect possible debris generated by the abatement procedure.

4.1.2.3 Establish a three-chamber decontamination unit in accordance with OSHA 29 CFR 1926.1101 and Article 4.2 with functional shower. The decontamination unit is not required to be contiguous to the removal area.

4.1.3 Modified Negative Pressure Enclosure (floor tile, floor tile mastic, cove base mastic, ceiling tile mastic, and chalk board mastic) -

4.1.3.1 The buildings existing electrical outlets may be utilized in all modified negative pressure enclosures providing all Contractors electrical equipment needed to perform the work be attached to portable ground fault circuit interrupter (GFCI's).

4.1.3.2 Seal all other openings from the work area, including but not limited to: doorways; windows; diffusers, return and relief grilles, and any other HVAC openings; and any other penetrations, with two layers of 6-mil polyethylene sheeting sealed with tape.

4.1.3.3 Introduce scaffolding and other large equipment that will not pass through the work area isolation structure.

4.1.3.4 Install HEPA-filtered air filtration devices (AFD) into the work area and vent exhaust ducts through openings to the outside atmosphere.

4.1.3.5 Pre-clean fixed and immovable objects and/or contaminated furniture and materials within the work area using HEPA-equipped vacuums and/or wet cleaning methods as appropriate, and enclose with polyethylene film and seal with tape.

4.1.3.6 Pre-clean contaminated furniture and materials within the work area using HEPA-equipped vacuums and/or wet cleaning methods as appropriate. Remove any decontaminated furniture and materials from the work area and store or discard as directed by the Owner.

4.1.3.7 Establish a three-chamber decontamination unit in accordance with OSHA 29 CFR 1926.1101 and Article 4.2 with functional shower. The decontamination unit is not required to be contiguous to the removal area.

4.2 ASSOCIATED WORK AREA COMPONENTS

4.2.1 Decontamination Enclosure Systems

4.2.1.1 General - Build suitable framing and/or use existing rooms connected with framed-in tunnels, if necessary, and line with plastic sealed with tape at all lap joints for all enclosures and decontamination enclosure systems rooms. Either existing rooms outside of the work area or specially framed and sealed temporary areas shall be used for the decontamination enclosure system. Convenience and proximity to the work area shall be the determining factors. In all cases, access between contaminated and uncontaminated rooms or areas shall be through an airlock, as described in Section 2.3.

4.2.1.2 Worker Decontamination Enclosure System - Construct a worker decontamination enclosure system contiguous to the work area that consists of three totally enclosed chambers as follows:

- An equipment room with two curtained doorways: one to the work area and one to the shower room.

- A shower room with two curtained doorways; one to the equipment room and one to the clean room. One shower shall be provided for every ten (10) workers or fraction thereof as required by 29 CFR 1910.141. To ensure against potential leakage, a metal pan with a minimum three-inch lip shall be installed underneath each shower facility. Ensure soap is available at all times in the shower room. The shower wastewater shall be drained, collected, and filtered through a system with at least 5-to-10-micron particle size collection capability. A system containing a series of several filters with progressively smaller pore sizes is recommended to avoid rapid clogging of filtration system by large particles. All expended filters shall be discarded as contaminated waste. Filtered water may be discharged to a sanitary or storm sewer drain.

- A clean room with one curtained doorway into the shower and one entrance or exit to uncontaminated areas of the building. The clean room shall have sufficient space for storage of workers' street clothes, towels, and other uncontaminated items.

  NOTE 1: The chambers of the decontamination unit shall be built large enough to facilitate proper personnel decontamination and efficient load outs of asbestos-containing waste and/or demolition debris. The enclosure shall be large enough for workers to change in privacy. The shower area itself shall be constructed on site and shall be required to have a wood or plastic grading so at no time the worker will be standing in contaminated water. The showerhead shall be firmly attached to the shower unit. There shall be no deviation to this requirement. The decontamination unit shall be thoroughly cleaned (every day) prior to the Contractor leaving the job site.

  NOTE 2: Use black plastic for the walls and curtains of the worker decontamination enclosure system to ensure the privacy of the workers. The top shall be covered with clear plastic to allow existing light into the decontamination enclosure.

4.2.2 Air Filtration System

4.2.2.1 Ensure that barriers and plastic linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.

4.2.2.2 Visually inspect enclosures at the beginning, during and following each work shift.

4.2.2.3 A pressure differential between the outside and inside work area shall be maintained at all times while abatement activity is in progress. The Contractor shall not allow any airflow out of the work area except through HEPA filtered air filtration devices.

4.2.2.4 The pressure differential shall be maintained so that the movement of tools, equipment, employees, and waste containers through the decontamination enclosure systems do not result in airflow out of the work area.

4.3 ASBESTOS REMOVAL AND DECONTAMINATION PROCEDURES

4.3.1. Negative Pressure Containment (cementitious pipe fitting insulation) -

4.3.1.1 After isolation of the work area is completed as specified, the asbestos-containing material should be wetted with amended water before removal. Small sections of the material shall be removed, wetted again with amended water, and immediately placed into approved disposal containers. All surfaces of the remaining components (including but not limited to steel and/or concrete decking, concrete and/or block walls, etc.) shall be thoroughly wet cleaned with sponges, cloths, or brushes. No visible asbestos-containing material shall remain. Containers that become full shall be sealed and labeled..

4.3.2 Glove Bag Removal Procedure (cementitious pipe fitting insulation) -

4.3.2.1 Glove bags shall be used in strict accordance with OSHA 29 CFR 1926.1101. Glove bag work shall be conducted by two person teams per glove bag. Each glove bag shall only be used once and may not be moved. In the event of area contamination (i.e., breached glove bag, improper work practice, etc.) the Contractor shall immediately stop work and isolate the immediate work area (as determined by the Owner or Owner's Representative). The Contractor shall then immediately proceed with cleaning of the entire isolated area(s) using HEPA-filtered vacuuming followed by wet wiping of all surfaces.

4.3.2.2 Glove bags shall be of 6-mil thickness and shall be seamless at the bottom. Cover floor in the vicinity of the work area and six (6) feet beyond with 6-mil polyethylene sheeting. Prior to installing the glove bag, completely cover all loose and friable materials adjacent to the glove bag operation with two layers of 6-mil polyethylene or encapsulate to render material intact.

4.3.2.3 Install the glove bag so that it completely covers the circumference of the pipe where the work is to be performed.

4.3.2.4 Modifications of glove bags shall not be permitted. Install per the manufacturer's instructions. All glove bags must be smoke tested, and all detectable leaks sealed prior to performing glove bag removal work.

4.3.2.5 Keep materials wet at all times during the removal process utilizing amended water. Immediately repair any leaks which occur during removal. Following removal of the materials, wash all materials down into the lower compartment of the glove bag. Thoroughly rinse the interior of the bag and encapsulate the interior of the bag and the substrate where the material has been removed.

4.3.2.6 Evacuate the air from inside the glove bag using a HEPA vacuum. With the removed insulation in the bottom of the bag, twist the bag several times and tape above the lower compartment to contain the material in the bottom of the bag. Remove the glove bag and promptly place in approved disposal container.

4.3.3 Floor Tile/Mastic Removal -

4.3.3.1 After isolation of the work area is completed as specified, mist the floor tile with amended water prior to scraping it from the substrate. The floor tile shall be removed using wood handle scrapers. Once the floor tiles have been removed from their substrate, they shall be placed into reinforced bags (i.e., rice bags) then placed into approved disposal containers.

4.3.3.2 After all floor tile has been removed, asbestos-containing mastic shall be dissolved using a commercially available solvent. Wood chips and/or wood shavings should be used to absorb the dissolved mastic prior to collection. Once the mastic has been removed, the mastic and wood shavings shall be placed into approved disposal containers. The floor surface shall be visibility clean with no mastic left in corners or around door frames.

4.3.4 Cove Base Mastic Removal -

4.3.4.1 After isolation of the work area is completed as specified, the cove base shall be taken off the wall, the mastic wetted with amended water, and the mastic removed using hand scrapers. Once the cove base and mastic have been removed from the wall they shall be placed into approved disposal containers.

4.3.5 Ceiling Tile Mastic Removal -

4.3.5.1 After isolation of the work area is completed as specified, the ceiling tiles shall be taken off, the adhesive wetted with amended water, and the mastic removed using hand scrapers. Once the ceiling tiles and mastic have been removed from the ceiling they shall be placed into approved disposal containers.

4.3.6 Chalk Board Adhesive Removal -

4.3.6.1 After isolation of the work area is completed as specified, the chalk board shall be taken off the wall, the adhesive wetted with amended water, and the adhesive removed using hand scrapers. Care should also be taken to ensure that mastic has been removed from the chalkboard. Once the adhesive has been removed it shall be placed into approved disposal containers.

4.4 REMOVAL AND DISPOSAL OF CONTAMINATED WASTE

4.4.1 Fill disposal containers to a level that workers can handle safely and with ease.

4.4.2 As disposal containers are filled, seal and move them to the staging area for decontamination.

4.4.3 Clean external surfaces of containers thoroughly by wet sponging in the designated areas that is part of the equipment decontamination enclosure system. Move containers to the washroom, wet-clean each container thoroughly, and move them to the holding areas pending removal to uncontaminated areas. Place decontaminated, sealed plastic bags containing asbestos material into a second clean bag; twist the bag opening tightly, bend the twisted end downward, and seal with tape. Move all disposal containers to the holding area to await disposal at an approved landfill. If glove bag techniques are used, place the glove bag into a clean bag; twist the bag opening tightly, bend the twisted end downward, seal with tape, and then move it to the holding area. Place danger labels on containers in accordance with 29 CFR 1926.1101. Identification labels shall also be placed on the outside of the first bag in accordance with 40 CFR Part 61, Subpart M. Ensure that containers are removed from the holding area by workers, dressed in clean coveralls, who have entered from uncontaminated areas. Ensure that workers do not enter from uncontaminated areas into the washroom of the work area; ensure that contaminated workers do not exit the work area through the equipment decontamination enclosure system.

4.4.4 To prevent exceeding available storage capacity on-site as the work progresses (if applicable), remove sealed and labeled containers of asbestos waste and dispose of such containers at an authorized disposal site in accordance with disposal regulatory requirements.

4.4.5 After the waste containers are decontaminated, the Contractor may make arrangements for a hauler or truck driver from the waste disposal site to transport the asbestos waste and

contaminated material to the disposal site. Transportation of all materials from each work area shall be in accordance with all applicable DOT and EPA regulations.

4.4.6 Transportation shall be by enclosed truck, trailer, or waste shipping container with the cargo area free of debris and lined with 6-mil polyethylene sheeting on floors and walls. Drums and/or bags shall be placed in the cargo area so as to prevent shifting and damage during transport. Asbestos warning signs shall be prominently posted during loading and unloading.

4.4.7 All asbestos-containing waste inside the work area shall be removed and items decontaminated before any cleanup work is started and before the isolation structures are dismantled.

4.4.8 The Contractor shall be responsible for determining current waste handling and disposal regulatory requirements and must comply with these regulations.

4.4.9 The Contractor shall ensure that all employees handling and discarding asbestos waste wear approved respiratory equipment and protective clothing.

4.4.10 In certain instances, plastic bags or fiber and metal drums may not be adequate or suitable to handle certain asbestos-containing materials. As an alternative, the Contractor may remove asbestos-containing material that is bulky or cumbersome in two layers of 6-mil plastic sheeting sealed tightly at all joints with tape and/or spray adhesive. The waste shall be properly labeled in accordance with current OSHA, DOT, and NESHAP requirements before transportation to the approved disposal site. All metal waste shall be deposited and disposed of in air and watertight drums. The drums shall be properly labeled before transportation to the appointed disposal site.

4.5 CLEANUP AND DECONTAMINATION OF THE WORK AREA

4.5.1 Asbestos Cleanup - Remove visible accumulations of asbestos material and debris. Wet-clean all surfaces within the work area.

4.5.2 Clean all surfaces in the work area and any other contaminated areas with water and/or with HEPA-filtered vacuum equipment. After cleaning the work area, wait twenty-four hours to allow dust to settle, and wet-clean and/or HEPA vacuum all surfaces in the work area a second time. After completion of the second cleaning operation, visually inspect the entire work area to ensure that it is free of visible asbestos debris.

4.5.3 Sealed containers and all equipment used in the work area shall be included in the cleanup and shall be removed from work areas, via the decontamination enclosure system, at an appropriate time in the cleaning sequence.

4.5.4 If the Owner finds visible accumulations of asbestos debris in the work area after cleaning, the Contractor shall repeat the wet cleaning until the work area passes inspection.

4.5.5 When the final inspection and subsequent final clearance air monitoring survey (if performed) determines the area is free of accumulated visible asbestos debris and airborne fibers, the decontamination enclosure system shall be removed and materials from the equipment room and shower shall be disposed of as contaminated waste.

4.5.6 To prevent exceeding available storage capacity on-site as the work progresses, sealed, and labeled containers of contaminated waste shall be removed and disposed of as contaminated waste.

4.6 DETERMINING ABATEMENT COMPLETION

4.6.1 Visual Inspection

4.6.1.1 The Contractor shall be required to conduct a thorough visual inspection of each work area after all asbestos-containing material has been completely removed.

4.6.1.2 Items to be checked during the visual inspection include, but are not limited to, the following:

- The adequacy of removal of asbestos-containing materials from their substrate.
- The presence of adhering material or accumulated material on exposed surfaces.

Only after the work area has passed the visual inspection will the Contractor be permitted to apply sealant materials.

4.7 SEALANT APPLICATION FOR LOCKDOWN

4.7.1 In all areas from where asbestos-containing materials are removed (including glove bag), an approved sealant shall be used to lock down residual fibers to their substrate.

4.7.2 The sealant shall be applied to all surfaces within the containment.

4.7.3 The sealant shall be applied with low-pressure airless spray equipment.

4.7.4 The sealant shall be used and applied in strict accordance with manufacturer's specifications.

4.7.5 The Contractor shall apply a thin, visible, contiguous film of sealant to all areas specified. Additional applications shall be required if the first application does not adequately cover the substrates.

4.8 FINAL AIR MONITORING

4.8.1 Final air sampling will be performed to determine and document air quality upon completion of abatement activities within full negative pressure containments. The consultant shall perform the final air sampling after the worksite has passed the final visual inspection and the polyethylene walls have been removed. Samples will be collected by use of high-volume electric sampling pumps calibrated to a maximum flow rate of 10 liters/minute. Final clearance air samples shall be collected and analyzed using Phase-Contrast Microscopy (PCM) and/or Transmission Electron Microscopy (TEM).

4.8.1.1 Acceptable Final Air Clearance Concentrations by PCM - Clearance air samples will be collected from several locations in the work area and in the adjacent worker decontamination area. Samples will be analyzed by PCM using NIOSH Method No. 7400. Total airborne fiber levels in all locations in the work area (as determined by phase-contrast microscopy) must be equal to or less than 0.01 fiber/cubic centimeters of air. If anyone air sample collected within the work area is equal to or greater than 0.01 fiber/cubic centimeters, the Contractor shall re-clean the work area with HEPA-filtered vacuum equipment and damp cloths/mops. A second set of final air samples will be collected and analyzed by the Consultant at the Contractor's expense.

4.8.1.2 Acceptable Final Air Concentrations by TEM - A total of thirteen (13) TEM samples may be required: five (5) samples collected inside all applicable abatement work areas, five (5) samples collected outside all applicable abatement work areas, two (2) field blanks, and one (1) sealed blank per the requirements of EPA 40 CFR Part 763, Appendix A. If the average of the 5 inside sample concentrations is less than or equal to 70 structures per millimeter squared (70 s/mm2),

the work area shall be considered clean. In the event the TEM samples fail to pass the clearance criteria as listed, the Contractor shall be required to re-clean the contained work area and re-encapsulate all specified surfaces. All cost associated with the analysis of a second and/or subsequent set(s) of TEM samples shall be borne by the Contractor.

Appendix A

Final Documentation Audit

FINAL DOCUMENTATION AUDIT

Throughout the progress of the Work, the Contractor's Supervisor or Foreman of each crew shall generate the following documentation to be submitted to the Consultant at Substantial Completion. The Contractor shall be required to submit all items listed below before final payment can be issued.

1. Air monitoring data.
2. Copies of all transport and disposal manifest.
3. Daily project log.
4. Accreditation and worker medical documentation for all Contractor employees.
5. Copy of Contractor's Ohio Abatement License.
6. Copy of Contractor’s Workers Compensation/Insurance Certificates.
7. Safety Data Sheets on all chemicals used on the project.
8. Landfill forms/dump receipts.
9. EPA notification(s).

Close out documentation shall be forwarded to the Consultant within 30 calendar days upon completion of the project

Appendix B

Asbestos-Containing/Universal-Hazardous Waste Materials Inspection Report

Cincinnati

3959 Fulton Grove Rd.
Cincinnati, Ohio 45245
(513) 752-9111
(513) 752-7973 (Fax)

Cleveland

3100 East 45th Street
Suite 446
Cleveland, Ohio 44127
(216) 916-7378
(513) 752-7973 (Fax)

Services

Phase I ESA's
Phase II Investigations
Asbestos
Energy Efficiency
Lead-Based Paint
Industrial Hygiene
Indoor Air Quality/Mold
Radon
Safety
Training

Asbestos-Containing Materials/Universal-Hazardous Waste Materials Inspection Report

Winton Woods Intermediate School
825 Waycross Road
Cincinnati, Ohio 45240

Prepared for:

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1.0 Executive Summary

1.1 Background

m.a.c. Paran Consulting Services, Inc. performed a pre-renovation asbestos inspection at Winton Woods Intermediate School, 825 Waycross Road, Cincinnati Ohio. The objectives of the inspection were to; (1) identify, by type and location, friable and on-friable asbestos-containing materials [ACM] throughout the structure; (2) assess the current condition of the ACM identified; (3) provide estimated quantities of ACM; and (4) inventory universal/hazardous wastes. The inspections were conducted by Mr. Samuel C. Prather, certified Ohio Asbestos Hazard Evaluation Specialists (License #ES36284) and Mr. Paul Cordy, certified Ohio Asbestos Hazard Evaluation Specialists (License #ES34509) in July 2019.

1.2 Inspection Results

The following is a summary of the materials confirmed by the laboratory, or assumed, to contain >1% asbestos. Please note that the quantities provided in this summary are approximate amounts, and should be verified by an abatement contractor prior to the onset of removal activities.

- **9" Floor Tile/Mastic** - Approximately 32,580 square feet of asbestos-containing 9" floor tile and mastic were identified throughout the building. The materials are in a non-friable condition.

- **12" Floor Tile/Mastic** - Approximately 10,585 square feet of asbestos-containing 12" floor tile and mastic were identified throughout the building. The materials are in a non-friable condition.

- **12" Cream with Black Dots Floor Tile** - Approximately 80 square feet of asbestos-containing 12" cream floor tile with black dots was identified in hallway 110. The material is in a non-friable condition.

- **Cementitious Fitting Insulation** - Approximately 926 asbestos-containing cementitious fittings between sections of fiberglass pipe insulation were identified, or assumed, throughout the building. The material is in good condition.

- **Mastic on 12" Acoustical Ceiling Tile** - Approximately 571 square feet of 12" acoustical ceiling tile with asbestos-containing mastic was identified in rooms 146, 146A, and 146B. The material is in a non-friable condition.

- **Window Bedding** - Approximately 1,944 linear feet (81 windows) of asbestos containing window bedding was identified on the exterior and interior of the metal windows located throughout the building. The material is in a non-friable condition.

- **Black Cove Base Mastic** - Approximately 7,436 linear feet of asbestos-containing black cove base mastic was identified throughout the building. The material is in a non-friable condition.

- **Vibration Gasket** - Approximately 40 square feet of asbestos-containing vibration gasket material was assumed in room 138 and the hallway 142. The material is in a non-friable condition.

- **Vapor Barrier Beneath Gymnasium Floor** - Approximately 6,935 square feet of asbestos-containing vapor barrier was assumed to be located beneath the wood gymnasium floor. The material is in an unknown condition.

- **Chalk Board Adhesive** - Approximately 1,844 square feet of asbestos-containing chalk board adhesive was assumed to be located throughout the building. The material is in an unknown condition.

- **Roofing Material** - Approximately 81,200 square feet of roofing material located on the exterior of the building was assumed to contain asbestos. The material is in a non-friable condition.

Note 1: While care was taken during the inspection to identify all asbestos-containing materials, additional materials may be located within non-accessible areas of the structure (e.g., behind walls, above intact ceilings, inside concealed pipe chases, etc.). If, through renovation or demolition these materials are discovered, they should be treated as asbestos-containing until further testing proves otherwise.

Note 2: Approximately 6,232 square feet of drywall with joint compound containing <1% asbestos was identified throughout the building. The composite of the drywall and joint compound is also <1% asbestos.

Note 3: Approximately 48 square feet of roof drain insulation containing <1% asbestos was identified throughout the building.

Note 4: Approximately 1,944 linear feet (130 square feet) of window caulking containing <1% asbestos was identified throughout the building.

Note 5: When access into block walls is permitted, an inspection for the presence of asbestos-containing vermiculite should be conducted.

1.3 Universal/Hazardous Waste Inspection Results

The universal/hazardous waste inventory is provided in Appendix C.

2.0 Inspection Procedures

2.1 General Asbestos Inspection and Sampling Procedures

The inspection was performed following a modified protocol of the EPA Asbestos Hazard Emergency Response Act (40 CFR 763.90) commonly known as "AHERA". Although originally required only for public and private school structures housing kindergarten through 12th-grade classes, it has become the accepted industry standard for conducting asbestos investigations in all types of structures. Most recently, the Occupational Safety and Health Administration revised its Asbestos in Construction Industry standard (29 CFR 1926.1101) to reference AHERA as the required method of conducting asbestos inspections in all public and commercial structures.

The vast majority of physically accessible spaces within the structure were accessed and inspected for suspect asbestos-containing materials. The Inspector then grouped suspect materials into homogeneous areas for sampling. A homogeneous area consists of materials with like appearance, color, texture, and application date. A physical assessment (visual observation and touching the material) was also made of the current condition and degree of friability for each identified material (a material is considered friable if it can be crumbled using hand pressure). A list of homogeneous areas identified for this assessment is included on the Bulk Sample Summary Table.

The Inspector assessed all identified asbestos-containing materials. The inspection encompassed both friable and non-friable materials. The Inspector then assumed that the specific material remained homogeneous (based upon the material's appearance and application) throughout the structure. In situations where materials appeared to alternate between asbestos containing and non-asbestos containing, the Inspector looked for visible differences between materials. If differences were not apparent, the Inspector made a professional decision to err on the side of conservatism and assumed that all materials were asbestos-containing.

The Inspector made every effort to locate all asbestos-containing materials identified during the limited inspection; however, should unidentified suspect asbestos-containing materials be discovered, please contact m.a.c. Paran Consulting Services, Inc. for assistance in material identification.

2.2 Method of Sampling and Analysis

2.2.1 Bulk Sample Collection Methods

To avoid disturbing suspected asbestos-containing materials more than necessary and minimize the potential release of asbestos fibers, the Inspector performed bulk sampling in accordance with the industry accepted procedures outlined in the current EPA Guidance Document and the AHERA sampling protocol. Each sample collected was pre-wetted and obtained using a clean coring tool, utility knife, or other appropriate tool. Each sample was then placed in a clean, sealable vial and labeled with a unique sample identification number. Care was taken to obtain a sample that was representative of all layers of a material. To avoid cross-contamination, the tools used for sample collection were thoroughly cleaned before collecting the next sample. If requested, the sample site was labeled with a pre-printed adhesive-backed sample identification tag bearing the corresponding sample identification number. Pertinent sample information was recorded on a standardized bulk sample log sheet including the date of inspection, name of the Inspector, a brief description and the location of the sample, and the type of material sampled (e.g., thermal systems insulation).

2.2.2 Analysis of Bulk Samples

Bulk samples were analyzed for asbestos content by Polarized-Light Microscopy (PLM) and dispersion staining (Method Reference: EPA/600/R-931/116). This analytical method, which EPA currently recommends, for the determination of asbestos in bulk samples, can be used for qualitative identification of six morphologically different types of asbestos fibers: chrysotile, amosite, crocidolite, anthophyllite, tremolite, and actinolite asbestos.

PLM analysis requires the microscopist to take a portion of the sample and treat it with an oil of a specific refractive index. This prepared slide is then subjected to a variety of tests while being viewed under varying polarizations of light. Each asbestos type displays unique characteristic when subjected to these tests. Percentages of the identified types of asbestos are determined by visual estimation.

For samples containing low concentrations of asbestos, the Inspector may choose to have the laboratory perform point count analysis. This additional step is employed to more accurately determine the percent of asbestos that is in the material being sampled. Using the point counting procedure, eight mounts are made by dispersing eight sub-samples of the bulk sample into a suitable fluid. A reticule is placed on the eyepiece of the microscope that superimposes a grid of points over the field of view. Fifty non-empty points are examined for each mount, yielding 400 points, some of which may be identified as asbestos and the rest as non-asbestos material. A simple calculation gives the percentage asbestos; 4 points in 400 would be 1.0%.

2.2.3 Reporting of Analysis Results

The method specifies that the asbestos content in a bulk sample shall be estimated and reported as a finite percentage (rounded to the nearest percent) within the range of 0 to 100. Minute quantities of asbestos in bulk samples may be reported as “trace” (tr) or less than 1 percent. The composition of the bulk sample is reported in percentages of asbestos (i.e., chrysotile, amosite, crocidolite, or other) and non-asbestos (i.e., cellulose, fiberglass, mineral wool, synthetic, or other) components. The original laboratory reports are presented in Appendix A.

2.2.4 Laboratory

Analysis of all suspect asbestos-containing materials was performed by Eurofins CEI Laboratory, 730 SE Maynard Road, Cary NC 27511 using polarized light microscopy. Eurofins CEI successfully participates in, and is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP), administered by the National Institute of Standards and Technology.

2.3 Physical and Hazard Assessment

2.3.1 Physical Assessment Factors

Per AHERA requirements, the Inspector performed a physical assessment of all friable asbestos-containing materials. This involved physically observing and documenting the current condition of each friable material and assessing its potential for future disturbance (or fiber release potential).

The Inspector categorized the materials’ current condition as Good, Fair, or Poor. AHERA protocol is not specific as to how these categories are arrived at, but in general the following guideline is used:

- Good – less than 10% area damage
- Fair – more than 10%, but less than 25% area damage
- Poor – more than 25% area damage

The Inspector then made an assessment of the materials’ potential for future disturbance (or fiber release potential) using the general factors listed in Table 2-1 on the following page. The first three factors focus on the current condition of the asbestos-containing material. Evidence of deterioration, delamination, physical damage, or water damage indicates that fiber release has occurred, is occurring, or is likely to occur in the future. Such evidence is based on the appearance of the material and/or the presence of dislodged or crumbled material in the surrounding area. The first three factors focus on the potential for fiber release due to disturbance or erosion. Surface erosion is likely to occur when asbestos-containing materials are located in air plenums or near forced-air streams. Exposed and easily accessible materials in areas frequented by structure occupants, or subject to mechanical vibrations are more vulnerable to disturbance or damage than materials in other locations.

Table 2-1: Factors for Assessing Potential Fiber Release
Current Condition of Asbestos-Containing Materials
• Evidence of deterioration or delamination from the underlying surface (substrate) • Evidence of physical damage (e.g., presence of debris) • Evidence of water damage
Potential for Future Disturbance, Damage, or Erosion of Asbestos-Containing Material
• Proximity to air plenum or direct airstream • Visibility, accessibility (to structure occupants and maintenance personnel), and degree of activity (air movement, vibration, movement of structure occupants) • Change in structure use

2.3.2 Hazard Assessment Factors

Based upon the physical assessment, friable asbestos-containing materials are then given a hazard rank with corresponding response options to aid the structure owner in prioritizing response actions. The hazard ranks range from 7 – most hazardous, to 1 – least hazardous as shown in Table 2-2 below. The highest rank is reserved for materials that are "significantly damaged" or material that is so extensively damaged that it requires immediate corrective action. Hazard ranks 4 – 6 reflect materials which are "damaged" with rank 6 indicating a high potential for further damage, and rank 5 indicating a moderate potential for damage. Hazard rank 4 denotes that a material has been damaged; however, the potential for any further damage is low. Hazard ranks 1 – 3 are reserved for materials currently in good condition with future disturbance potentials being high, moderate, or low (3, 2, 1, respectively). Non-friable materials are categorized as non-friable.

Table 2-2: Classifications for Hazard Potential of Friable Asbestos-Containing Materials		
Hazard Rank	**Condition**	**Disturbance Potential**
7	Poor	Any
6	Fair	High
5	Fair	Moderate
4	Fair	Low
3	Good	High
2	Good	Moderate
1	Good	Low

2.3.3 Physical and Hazard Assessments of Materials Encountered

The physical and hazard assessments made for all asbestos-containing materials identified during this inspection can be found in Section 4.0 “Inventory of Asbestos-Containing Materials”.

3.0 Bulk Sample Data Summary

The following table presents the results of suspect materials sampled.

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Room 101	Cementitious Fitting Insulation	1	WWI-1	Chrysotile 10%
Room 135D	Cementitious Fitting Insulation	1	WWI-2	Positive Stop Analysis
Room 129	Cementitious Fitting Insulation	1	WWI-3	Positive Stop Analysis
Room 129	Rope Gasket	2	WWI-4	None Detected
Room 129	Rope Gasket	2	WWI-5	None Detected
Hallway 134	Roof Drain Insulation	3	WWI-6	<0.25% Chrysotile¥
Room 134	Roof Drain Insulation	3	WWI-7	<0.25% Chrysotile¥
Room 122	12” Grey with Blue Flecks Floor Tile	4A	WWI-8	None Detected
Room 122	Mastic on HA# 4A	4B	WWI-8	None Detected
Hallway 107	12” Grey with Blue Flecks Floor Tile	4A	WWI-9	None Detected
Hallway 107	Mastic on HA# 4A	4B	WWI-9	None Detected
Room 139	2’x4’ Fissured Ceiling Tile	5	WWI-10	None Detected
Room 142	2’x4’ Fissured Ceiling Tile	5	WWI-11	None Detected
Hallway 108	Black Cove Base Mastic	6	WWI-12	Chrysotile 2%
Room 106	Black Cove Base Mastic	6	WWI-13	Positive Stop Analysis
Room 122	Drywall	7	WWI-14	None Detected

¥ verified by point count analysis

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Hallway 107	Drywall	7	WWI-15	None Detected
Stage	9” Grey Floor Tile	8A	WWI-16	Chrysotile 10%
Stage	Mastic on HA# 8A	8B	WWI-16	Chrysotile 5%
Stage	9” Grey Floor Tile	8A	WWI-17	Positive Stop Analysis
Stage	Mastic on HA# 8A	8B	WWI-17	Positive Stop Analysis
Room 132	9” Olive Green Floor Tile	9A	WWI-18	Chrysotile 10%
Room 132	Mastic on HA# 9A	9B	WWI-18	Chrysotile 8%
Room 132	9” Olive Green Floor Tile	9A	WWI-19	Positive Stop Analysis
Room 132	Mastic on Ha# 9A	9B	WWI-19	Positive Stop Analysis
Room 134	Red Mastic on Fiberglass Lines/Fittings	10	WWI-20	None Detected
Hallway 105	Red Mastic on Fiberglass Lines/Fittings	10	WWI-21	None Detected
Room 139B	Hard Plaster	11	WWI-22	None Detected
Room 156	Hard Plaster	11	WWI-23	None Detected
Room 151	Hard Plaster	11	WWI-24	None Detected
Hallway 104	Hard Plaster	11	WWI-25	None Detected
Hallway 105	Hard Plaster	11	WWI-26	None Detected
Room 126	Hard Plaster	11	WWI-27	None Detected

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Room 140C	Hard Plaster	11	WWI-28	None Detected
Room 147	12” Blue with Blue Flecks Floor Tile	13A	WWI-29	None Detected
Room 147	Mastic on HA# 13A	13B	WWI-29	Chrysotile 2%
Room 147	Mastic beneath HA# 13A and HA# 13B	13C	WWI-29	Chrysotile 2%
Room 147	Leveling Compound beneath HA# 13C	13D	WWI-29	None Detected
Room 142	12” Blue with Blue Flecks Floor Tile	13A	WWI-30	None Detected
Room 142	Mastic on HA# 13A	13B	WWI-30	Positive Stop Analysis
Room 142	9” Green with White Streaks beneath HA# 13A and HA# 13B	12A	WWI-30	Chrysotile 10%
Room 142	Mastic on HA# 12A	12B	WWI-30	Chrysotile 2%
Room 146A	12” Acoustical Ceiling Tile	14A	WWI-31	None Detected
Room 146A	Mastic on HA# 14A	14B	WWI-31	Chrysotile 2%
Room 146B	12” Acoustical Ceiling Tile	14A	WWI-32	None Detected
Room 146B	Mastic on HA# 14A	14B	WWI-32	Positive Stop Analysis
Hallway 101	Drywall/Joint Compound	15	WWI-33	Drywall- None Detected Joint Comp.- Chrys. 0.25%¥ Composite- Chrys. 0.013%¥
Hallway 201	Drywall/Joint Compound	15	WWI-34	Drywall- None Detected Joint Comp.- Chrys. 0.50%¥ Composite- Chrys. 0.025%¥
Room 140D	12” Light Blue Floor Tile	16A	WWI-35	None Detected
Room 140D	Mastic on HA# 16A	16B	WWI-35	None Detected

¥ verified by point count analysis

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Room 140	12” Light Blue Floor Tile	16A	WWI-36	None Detected
Room 140	Mastic on HA# 16A	16B	WWI-36	None Detected
Room 140	2’x4’ Pinhole Ceiling Tile	17	WWI-37	None Detected
Room 140	2’x4’ Pinhole Ceiling Tile	17	WWI-38	None Detected
Room 140A	Sink Undercoating	18	WWI-39	None Detected
Room 140A	Sink Undercoating	18	WWI-40	None Detected
Hallway 105	12’ Cream with Black Flecks Floor Tile	19A	WWI-41	Chrysotile 2%
Hallway 105	Mastic on HA# 19A	19B	WWI-41	Chrysotile 8%
Hallway 102	12” Cream with Black Flecks Floor Tile	19A	WWI-42	Positive Stop Analysis
Hallway 102	Mastic on HA# 19A	19B	WWI-42	Positive Stop Analysis
Hallway 108	12” Olive Green Floor Tile	20A	WWI-43	Chrysotile 3%
Hallway 108	Mastic on HA# 20A	20B	WWI-43	Chrysotile 5%
Hallway 102	12” Olive Green Floor Tile	20A	WWI-44	Positive Stop Analysis
Hallway 102	Mastic on HA# 20A	20B	WWI-44	Positive Stop Analysis
Hallway 104	2’x4’ Textured Pinhole Ceiling Tile	21	WWI-45	None Detected
Hallway 101	2’x4’ Textured Pinhole Ceiling Tile	21	WWI-46	None Detected

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Room 115	9” Grey with White Flecks Floor Tile	22A	WWI-47	Chrysotile 5%
Room 115	Mastic on HA# 22A	22B	WWI-47	Chrysotile 5%
Room 131	9” Grey with White Flecks Floor Tile	22A	WWI-48	Positive Stop Analysis
Room 131	Mastic on HA# 22A	22B	WWI-48	Positive Stop Analysis
Room 105	12” Cream with Brown Flecks Floor Tile	23A	WWI-49	None Detected
Room 105	Mastic on HA# 23A	23B	WWI-49	None Detected
Room 105	12” Cream with Brown Flecks Floor Tile	23A	WWI-50	None Detected
Room 105	Mastic on HA# 23A	23B	WWI-50	None Detected
Room 114	12” Blue with White Flecks Floor Tile	24A	WWI-51	None Detected
Room 114	Mastic on HA# 24A	24B	WWI-51	None Detected
Room 110A	12” Blue with White Flecks Floor Tile	24A	WWI-52	None Detected
Room 110A	Mastic on HA# 24A	24B	WWI-52	None Detected
Room 110B	9” Cream with White Flecks Floor Tile	25A	WWI-53	Chrysotile 2%
Room 110B	Mastic on HA# 25A	25B	WWI-53	Chrysotile 5%
Room 110B	9” Cream with White Flecks Floor Tile	25A	WWI-54	Positive Stop Analysis
Room 110B	Mastic on HA# 25A	25B	WWI-54	Positive Stop Analysis

Table 3-1: Bulk Sample Summary				
Room/Location	**Material Description**	**Homogeneous Area No. (HA)**	**Sample Number**	**Laboratory Results**
Hallway 110	12” Cream with Black Dots Floor Tile	26A	WWI-55	Chrysotile 5%
Hallway 110	Mastic on HA# 26A	26B	WWI-55	None Detected
Hallway 110	12” Cream with Black Dots Floor Tile	26A	WWI-56	Positive Stop Analysis
Hallway 110	Mastic on HA# 26A	26B	WWI-56	None Detected
Room 218	9” Tan with White Flecks Floor Tile	27A	WWI-57	Chrysotile 10%
Room 218	Mastic on HA# 27A	27B	WWI-57	Chrysotile 8%
Room 219	9” Tan with White Flecks Floor Tile	27A	WWI-58	Positive Stop Analysis
Room 219	Mastic on HA# 27A	27B	WWI-58	Positive Stop Analysis
Hallway 201	12” Green with Black Flecks Floor Tile	28A	WWI-59	Chrysotile 3%
Hallway 201	Mastic on HA# 28A	28B	WWI-59	Chrysotile 8%
Hallway 201	12” Green with Black Flecks Floor Tile	28A	WWI-60	Positive Stop Analysis
Hallway 201	Mastic on HA# 28A	28B	WWI-60	Positive Stop Analysis
Room 111	Bedding on Metal Windows	29	WWI-61	Chrysotile 2%
Room 131	Bedding on Metal Windows	29	WWI-62	Positive Stop Analysis
Exterior of Building	Window Caulking	30	WWI-63	0.22% Chrysotile¥¥
Exterior of Building	Window Caulking	30	WWI-64	0.38% Chrysotile¥¥

¥ ¥ verified by gravimetric point count analysis

4.0 Inventory of Asbestos-Containing Materials

The following table presents a list of asbestos-containing materials identified during the inspection.

Table 4-1: Asbestos-Containing Materials Inventory

Room/Location	Material Type	Condition/ Hazard Rank	Estimated Quantity
Room 129	Cementitious Fitting Insulation	Good/3	39 fittings
Room 122	Cementitious Fitting Insulation	Good/3	8 fittings
Room 123	Cementitious Fitting Insulation	Good/3	3 fittings
Hallway 107	Cementitious Fitting Insulation	Good/3	1 fitting
Room 125/125A	Cementitious Fitting Insulation	Good/3	10 fittings
Cafeteria	Cementitious Fitting Insulation	Good/3	24 fittings
Room 136A	Cementitious Fitting Insulation	Good/3	24 fittings
Room 136D	Cementitious Fitting Insulation	Good/3	61 fittings
Room 137	Cementitious Fitting Insulation	Good/2	96 fittings (assumed)
Room 132	Cementitious Fitting Insulation	Good/3	6 fittings
Room 126	Cementitious Fitting Insulation	Good/3	8 fittings
Room 127	Cementitious Fitting insulation	Good/3	20 fittings
Room 146A	Cementitious Fitting Insulation	Good/3	12 fittings
Room 146C	Cementitious Fitting Insulation	Good/3	6 fittings
Room 146	Cementitious Fitting Insulation	Good/3	12 fittings

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 146B	Cementitious Fitting Insulation	Good/3	8 fittings
Room 144	Cementitious Fitting Insulation	Good/3	1 fitting
Room 143	Cementitious Fitting Insulation	Good/3	7 fittings
Room 142	Cementitious Fitting Insulation	Good/3	16 fittings
Room 140D	Cementitious Fitting Insulation	Good/3	11 fittings
Room 140C	Cementitious Fitting Insulation	Good/3	22 fittings
Room 140B	Cementitious Fitting Insulation	Good/3	1 fitting
Room 139C	Cementitious Fitting Insulation	Good/3	1 fitting
Room 138	Cementitious Fitting Insulation	Good/3	13 fittings
Hallway 103	Cementitious Fitting Insulation	Good/3	3 fittings
Hallway 102	Cementitious Fitting Insulation	Good/3	10 fittings
Hallway 101	Cementitious Fitting Insulation	Good/3	51 fittings
Room 131/131A	Cementitious Fitting Insulation	Good/3	16 fittings
Room 103	Cementitious Fitting Insulation	Good/3	6 fittings
Room 102	Cementitious Fitting Insulation	Good/3	7 fittings
Hallway 109	Cementitious Fitting Insulation	Good/3	16 fittings
Room 101 A/B	Cementitious Fitting Insulation	Good/3	28 fittings

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 104	Cementitious Fitting Insulation	Good/3	9 fittings
Room 105	Cementitious Fitting Insulation	Good/3	9 fittings
Room 107	Cementitious Fitting Insulation	Good/3	9 fittings
Room 108	Cementitious Fitting Insulation	Good/3	8 fittings
Room 151	Cementitious Fitting Insulation	Good/3	9 fittings
Room 153	Cementitious Fitting Insulation	Good/3	9 fittings
Room 152	Cementitious Fitting Insulation	Good/3	11 fittings
Room 106	Cementitious Fitting Insulation	Good/3	10 fittings
Room 109	Cementitious Fitting Insulation	Good/3	9 fittings
Room 110A	Cementitious Fitting Insulation	Good/3	4 fittings
Room 110B	Cementitious Fitting Insulation	Good/3	7 fittings
Room 111	Cementitious Fitting Insulation	Good/3	7 fittings
Room 112	Cementitious Fitting Insulation	Good/3	7 fittings
Hallway 108	Cementitious Fitting Insulation	Good/3	27 fittings
Room 113	Cementitious Fitting Insulation	Good/3	5 fittings
Room 114	Cementitious Fitting Insulation	Good/3	13 fittings
Room 115	Cementitious Fitting Insulation	Good/3	7 fittings

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 116	Cementitious Fitting Insulation	Good/3	7 fittings
Room 117	Cementitious Fitting Insulation	Good/3	7 fittings
Room 118	Cementitious Fitting Insulation	Good/3	7 fittings
Room 119	Cementitious Fitting Insulation	Good/3	9 fittings
Room 121	Cementitious Fitting Insulation	Good/3	6 fittings
Hallway 105	Cementitious Fitting Insulation	Good/3	12 fittings
Room 155	Cementitious Fitting Insulation	Good/3	16 fittings
Room 156	Cementitious Fitting Insulation	Good/3	16 fittings
Room 157	Cementitious Fitting Insulation	Good/3	2 fittings
Hallway 110	Cementitious Fitting Insulation	Good3	21 fittings
Room 214	Cementitious Fitting Insulation	Good/3	7 fittings
Room 213	Cementitious Fitting Insulation	Good/3	7 fittings
Room 212	Cementitious Fitting Insulation	Good/7	7 fittings
Room 218	Cementitious Fitting Insulation	Good/3	7 fittings
Room 222	Cementitious Fitting Insulation	Good/3	11 fittings
Room 214	Cementitious Fitting Insulation	Good/3	7 fittings
Room 215	Cementitious Fitting Insulation	Good/3	7 fittings

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 216	Cementitious Fitting Insulation	Good/3	10 fittings
Room 219	Cementitious Fitting Insulation	Good/3	15 fittings
Room 217	Cementitious Fitting Insulation	Good/2	7 fittings
Room 220	Cementitious Fitting Insulation	Good/3	7 fittings
Room 221	Cementitious Fitting Insulation	Good/3	10 fittings
Hallway 201	Cementitious Fitting Insulation	Good/3	14 fittings
Room 136	9” Grey Floor Tile/Mastic	Non-Friable	3,034 sf.
Room 136C	9” Grey Floor Tile/Mastic	Non-Friable	1,500 sf.
Room 132	9” Olive Green Floor Tile/Mastic	Non-Friable	384 sf.
Room 147	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Flecks Floor Tile/Mastic	Non-Friable	420 sf.
Room 146A	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	121 sf.
Room 146C	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	884 sf.
Room 146	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Streaks Floor Tile/Mastic	Non-Friable	1,440 sf.
Room 146B	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	77 sf.
Room 144	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Streaks Floor Tile/Mastic	Non-Friable	364 sf.
Room 143	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Streaks Floor Tile/Mastic	Non-Friable	414 sf.
Room 142	9” Green with White Streaks Floor Tile/Mastic beneath 12” Blue with Blue Streaks Floor Tile/Mastic	Non-Friable	54 sf.

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Hallway 103	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	315 sf.
Hallway 102	12” Olive Green Floor Tile/Mastic	Non-Friable	900 sf.
Hallway 101	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	900 sf.
Hallway 101	12” Olive Green Floor Tile/Mastic	Non-Friable	1,600 sf.
Room 131/131A	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	1,924 sf.
Room 148	9” Grey Floor Tile/Mastic	Non-Friable	300 sf.
Room 149	9” Grey Floor Tile/Mastic	Non-Friable	70 sf.
Room 150	9” Grey Floor Tile/Mastic	Non-Friable	70 sf.
Room 130	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	338 sf.
Hallway 109	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	330 sf.
Hallway 109	12” Olive Green Floor Tile/Mastic	Non-Friable	330 sf.
Room 104	9” Olive Green Floor Tile/Mastic	Non-Friable	675 sf.
Room 107	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	621 sf.
Room 108	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	690 sf.
Room 106	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	728 sf.
Room 102	9” Grey with White Floor Tile/Mastic	Non-Friable	700 sf.
Room 103	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	783 sf.

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 110B	9” Cream with White Flecks Floor Tile/Mastic	Non-Friable	675 sf.
Room 111	9” Green with White Streaks Floor Tile/Mastic	Non-Friable	728 sf.
Room 112	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	1,134 sf. (beneath carpet)
Hallway 108	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	1,100 sf.
Hallway 108	12” Olive Green Floor Tile/Mastic	Non-Friable	1,100 sf.
Room 113	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	1,196 sf.
Room 114	9” Grey with White Flecks Floor Tile	Non-Friable	1,196 sf. (beneath 12” tile)
Room 115	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	728 sf.
Room 116	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	728 sf.
Room 117	9” Grey Floor Tile/Mastic	Non-Friable	728 sf.
Room 118	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	728 sf.
Room 119	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	728 sf.
Hallway 105	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	1,000 sf
Hallway 105	12” Olive Green Floor Tile/Mastic	Non-Friable	1,000 sf
Room 120	9” Grey Floor Tile/Mastic	Non-Friable	1,040 sf.
Hallway 110	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	400 sf.
Hallway 110	12” Olive Green Floor Tile/Mastic	Non-Friable	400 sf.

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Hallway 110	12” Cream with Black Dots Floor Tile	Non-Friable	80 sf.
Room 214	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 213	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 215	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 212	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 216	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 217	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 218	9” Tan with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 219	9” Tan with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 220	9” Tan with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 221	9” Tan with White Streaks Floor Tile/Mastic	Non-Friable	702 sf.
Room 222	9” Grey with White Streaks Floor Tile/Mastic	Non-Friable	260 sf.
Hallway 201	12” Cream with Black Flecks Floor Tile/Mastic	Non-Friable	605 sf.
Hallway 201	12” Green with Black Flecks Floor Tile/Mastic	Non-Friable	605 sf.
Room 137B	9” Grey with White Flecks Floor Tile/Mastic	Non-Friable	100 sf.
Room 146A	Mastic on 12” Acoustical Tile	Non-Friable	121 sf.
Room 146	Mastic on 12” Acoustical Tile	Non-Friable	400 sf.

Table 4-1: Asbestos-Containing Materials Inventory			
Room/Location	**Material Type**	**Condition/ Hazard Rank**	**Estimated Quantity**
Room 146B	Mastic on 12” Acoustical Tile	Non-Friable	50 sf.
Exterior/Interior of Building	Bedding on Metal Windows	Non-Friable	1,944 lf.
Throughout Building	Black Cove Base Mastic	Non-Friable	7,436 lf.
Hallway 142	Vibration Gasket (assumed)	Non-Friable	20 sf.
Room 138	Vibration Gasket (assumed)	Non-Friable	20 sf.
Throughout Building	Chalkboard Mastic (assumed)	Unknown	1,844 sf.
Throughout Building	Roofing Materials (assumed)	Non-Friable	81,200 sf.
Gymnasium	Vapor Barrier (assumed)	Unknown	6,935 sf.

Appendix A

Laboratory Results

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July 22, 2019

Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

CLIENT PROJECT: WW Intermediate, 19-14.15
CEI LAB CODE: A1914163

Dear Customer:

Enclosed are asbestos analysis results for PLM Bulk samples received at our laboratory on July 15, 2019. The samples were analyzed for asbestos using polarizing light microscopy (PLM) per the EPA 600 Method.

Sample results containing >1% asbestos are considered asbestos-containing materials (ACMs) per EPA regulatory requirements. The detection limit for the EPA 600 Method is <1% asbestos by weight as determined by visual estimation.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Mac Paran Consulting Services, Inc.

CLIENT PROJECT: WW Intermediate, 19-14.15

LAB CODE: A1914163

TEST METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 07/22/19

TOTAL SAMPLES ANALYZED: 52

SAMPLES >1% ASBESTOS: 25

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: WW Intermediate, 19-14.15 **LAB CODE:** A1914163

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
WWI-1		A192790	Gray	Hard Fitting	Chrysotile 10%
WWI-2		A192791		Sample Not Analyzed per COC	
WWI-3		A192792		Sample Not Analyzed per COC	
WWI-4		A192793	Red	Rope Gasket	None Detected
WWI-5		A192794	Red	Rope Gasket	None Detected
WWI-6		A192795	Gray	Roof Drain	Chrysotile <1%
WWI-7		A192796	Gray	Roof Drain	Chrysotile <1%
WWI-8		A192797A	Gray,Blue	Floor Tile	None Detected
		A192797B	Yellow	Mastic	None Detected
WWI-9		A192798A	Gray,Blue	Floor Tile	None Detected
		A192798B	Yellow	Mastic	None Detected
WWI-10		A192799	White	Fissured Ct	None Detected
WWI-11		A192800	White	Fissured Ct	None Detected
WWI-12		A192801	Brown	Cove Base Mastic	Chrysotile 2%
WWI-13		A192802		Sample Not Analyzed per COC	
WWI-14		A192803	Gray	Drywall	None Detected
WWI-15		A192804	Gray	Drywall	None Detected
WWI-16		A192805A	Gray	Floor Tile	Chrysotile 10%
		A192805B	Black	Mastic	Chrysotile 5%
WWI-17		A192806A		Sample Not Analyzed per COC	
		A192806B		Sample Not Analyzed per COC	
WWI-18		A192807A	Olive Green	Floor Tile	Chrysotile 10%
		A192807B	Black	Mastic	Chrysotile 8%
WWI-19		A192808A		Sample Not Analyzed per COC	
		A192808B		Sample Not Analyzed per COC	
WWI-20		A192809	Red	Mastic	None Detected
WWI-21		A192810	Red	Mastic	None Detected
WWI-22	Layer 1	A192811	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192811	Gray	Hard Plaster Base Coat	None Detected
WWI-23	Layer 1	A192812	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192812	Gray	Hard Plaster Base Coat	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: WW Intermediate, 19-14.15 **LAB CODE:** A1914163

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
WWI-24	Layer 1	A192813	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192813	Gray	Hard Plaster Base Coat	None Detected
WWI-25	Layer 1	A192814	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192814	Gray	Hard Plaster Base Coat	None Detected
WWI-26	Layer 1	A192815	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192815	Gray	Hard Plaster Base Coat	None Detected
WWI-27	Layer 1	A192816	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192816	Gray	Hard Plaster Base Coat	None Detected
WWI-28	Layer 1	A192817	White	Hard Plaster Skim Coat	None Detected
	Layer 2	A192817	Gray	Hard Plaster Base Coat	None Detected
WWI-29		A192818A	Blue	Floor Tile	None Detected
	Layer 1	A192818B	Black	Mastic	Chrysotile 2%
	Layer 2	A192818B	Brown	Mastic	Chrysotile 2%
	Layer 3	A192818B	Gray	Leveling Compound	None Detected
WWI-30		A192819A	Blue	Floor Tile	None Detected
		A192819B		Sample Not Analyzed per COC	
		A192819C	Green	Floor Tile	Chrysotile 10%
		A192819D	Black	Mastic	Chrysotile 2%
WWI-31		A192820A	White	Ceiling Tile	None Detected
		A192820B	Brown	Mastic	Chrysotile 2%
WWI-32		A192821A	White	Ceiling Tile	None Detected
		A192821B		Sample Not Analyzed per COC	
WWI-33		A192822	Gray	Drywall/Joint Compound	Chrysotile <1%
WWI-34		A192823	Gray	Drywall/Joint Compound	Chrysotile <1%
WWI-35		A192824A	Blue	Floor Tile	None Detected
		A192824B	Yellow	Mastic	None Detected
WWI-36		A192825A	Blue	Floor Tile	None Detected
		A192825B	Yellow	Mastic	None Detected
WWI-37		A192826	White	Pinhole Ct	None Detected
WWI-38		A192827	White	Pinhole Ct	None Detected
WWI-39		A192828	White	Sink Undercoating	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: WW Intermediate, 19-14.15 **LAB CODE:** A1914163

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
WWI-40		A192829	White	Sink Undercoating	None Detected
WWI-41		A192830A	Cream	Floor TIle	Chrysotile 2%
		A192830B	Black	Mastic	Chrysotile 8%
WWI-42		A192831A		Sample Not Analyzed per COC	
		A192831B		Sample Not Analyzed per COC	
WWI-43		A192832A	Olive	Floor TIle	Chrysotile 3%
		A192832B	Black	Mastic	Chrysotile 5%
WWI-44		A192833A		Sample Not Analyzed per COC	
		A192833B		Sample Not Analyzed per COC	
WWI-45		A192834	White	Textured Pinhole Ct	None Detected
WWI-46		A192835	White	Textured Pinhole Ct	None Detected
WWI-47		A192836A	Gray	Floor TIle	Chrysotile 5%
		A192836B	Black	Mastic	Chrysotile 5%
WWI-48		A192837A		Sample Not Analyzed per COC	
		A192837B		Sample Not Analyzed per COC	
WWI-49		A192838A	Cream	Floor TIle	None Detected
		A192838B	Yellow	Mastic	None Detected
WWI-50		A192839A	Cream	Floor TIle	None Detected
		A192839B	Yellow	Mastic	None Detected
WWI-51		A192840A	Blue,White	Floor Tile	None Detected
		A192840B	Yellow	Mastic	None Detected
WWI-52		A192841A	Blue,White	Floor Tile	None Detected
		A192841B	Yellow	Mastic	None Detected
WWI-53		A192842A	Cream	Floor Tile	Chrysotile 2%
		A192842B	Black	Mastic	Chrysotile 5%
WWI-54		A192843A		Sample Not Analyzed per COC	
		A192843B		Sample Not Analyzed per COC	
WWI-55		A192844A	Cream	Floor Tile	Chrysotile 5%
		A192844B	Yellow	Mastic	None Detected
WWI-56		A192845A		Sample Not Analyzed per COC	
		A192845B	Yellow	Mastic	None Detected

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: WW Intermediate, 19-14.15 **LAB CODE:** A1914163

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
WWI-57		A192846A	Tan,White	Floor Tile	Chrysotile 10%
		A192846B	Black,White	Mastic	Chrysotile 8%
WWI-58		A192847A		Sample Not Analyzed per COC	
		A192847B		Sample Not Analyzed per COC	
WWI-59		A192848A	Green	Floor Tile	Chrysotile 3%
		A192848B	Black	Mastic	Chrysotile 8%
WWI-60		A192849A		Sample Not Analyzed per COC	
		A192849B		Sample Not Analyzed per COC	
WWI-61		A192850	Gray	Window Bedding	Chrysotile 2%
WWI-62		A192851		Sample Not Analyzed per COC	
WWI-63		A192852	White	Window Caulking	Chrysotile <1%
WWI-64		A192853	Black	Window Caulking	Chrysotile <1%

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-1 A192790	Hard Fitting	Homogeneous Gray Fibrous Bound	60% 10%	Mineral Wool Fiberglass	20%	Calc Carb	10% Chrysotile
WWI-2 A192791	Sample Not Analyzed per COC						
WWI-3 A192792	Sample Not Analyzed per COC						
WWI-4 A192793	Rope Gasket	Heterogeneous Red Fibrous Bound	80%	Fiberglass	20%	Caulk	None Detected
WWI-5 A192794	Rope Gasket	Heterogeneous Red Fibrous Bound	80%	Fiberglass	20%	Caulk	None Detected
WWI-6 A192795	Roof Drain	Homogeneous Gray Fibrous Bound	60% 20%	Mineral Wool Fiberglass	20%	Calc Carb	<1% Chrysotile
WWI-7 A192796	Roof Drain	Homogeneous Gray Fibrous Bound	60% 20%	Mineral Wool Fiberglass	20%	Calc Carb	<1% Chrysotile
WWI-8 A192797A	Floor Tile	Homogeneous Gray,Blue Non-fibrous Bound			100%	Vinyl	None Detected

ASBESTOS BULK ANALYSIS

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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
A192797B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
WWI-9 A192798A	Floor Tile	Homogeneous Gray,Blue Non-fibrous Bound			100%	Vinyl	None Detected
A192798B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
WWI-10 A192799	Fissured Ct	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
WWI-11 A192800	Fissured Ct	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
WWI-12 A192801	Cove Base Mastic	Homogeneous Brown Non-fibrous Bound			98%	Mastic	**2% Chrysotile**
WWI-13 A192802	Sample Not Analyzed per COC						
WWI-14 A192803	Drywall	Heterogeneous Gray Fibrous Bound	15% 5%	Cellulose Fiberglass	80% <1%	Gypsum Vermiculite	None Detected

ASBESTOS BULK ANALYSIS

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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-15 A192804	Drywall	Heterogeneous Gray Fibrous Bound	15% 5%	Cellulose Fiberglass	80% <1%	Gypsum Vermiculite	None Detected
WWI-16 A192805A	Floor Tile	Homogeneous Gray Non-fibrous Bound			90%	Vinyl	**10% Chrysotile**
A192805B	Mastic	Homogeneous Black Non-fibrous Bound			95%	Mastic	**5% Chrysotile**
WWI-17 A192806A	Sample Not Analyzed per COC						
A192806B	Sample Not Analyzed per COC						
WWI-18 A192807A	Floor Tile	Homogeneous Olive Green Non-fibrous Bound			90%	Vinyl	**10% Chrysotile**
A192807B	Mastic	Homogeneous Black Non-fibrous Bound			92%	Mastic	**8% Chrysotile**
WWI-19 A192808A	Sample Not Analyzed per COC						
A192808B	Sample Not Analyzed per COC						

ASBESTOS BULK ANALYSIS

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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-20 A192809	Mastic	Homogeneous Red Fibrous Bound	10%	Cellulose	90%	Mastic	None Detected
WWI-21 A192810	Mastic	Homogeneous Red Fibrous Bound	10%	Cellulose	90%	Mastic	None Detected
WWI-22 Layer 1 A192811	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
Layer 2 A192811	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
WWI-23 Layer 1 A192812	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
Layer 2 A192812	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
WWI-24 Layer 1 A192813	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound			75% 25%	Silicates Binder	None Detected

ASBESTOS BULK ANALYSIS

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Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	 Non-Fibrous	ASBESTOS %
Layer 2 A192813	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
WWI-25 Layer 1 A192814	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
Layer 2 A192814	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
WWI-26 Layer 1 A192815	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
Layer 2 A192815	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
WWI-27 Layer 1 A192816	Hard Plaster Skim Coat	Heterogeneous White Non-fibrous Bound	75% 25%	Silicates Binder	None Detected
Layer 2 A192816	Hard Plaster Base Coat	Heterogeneous Gray Non-fibrous Bound	75% 25%	Silicates Binder	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
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Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
WWI-28	Hard Plaster Skim Coat	Heterogeneous		75%	Silicates	None Detected
Layer 1		White		25%	Binder	
A192817		Non-fibrous				
		Bound				
Layer 2	Hard Plaster Base Coat	Heterogeneous		75%	Silicates	None Detected
A192817		Gray		25%	Binder	
		Non-fibrous				
		Bound				
WWI-29	Floor Tile	Homogeneous		100%	Vinyl	None Detected
A192818A		Blue				
		Non-fibrous				
		Bound				
Layer 1	Mastic	Homogeneous		98%	Mastic	2% Chrysotile
A192818B		Black				
		Non-fibrous				
		Bound				
Layer 2	Mastic	Homogeneous		98%	Mastic	2% Chrysotile
A192818B		Brown				
		Non-fibrous				
		Bound				
Layer 3	Leveling Compound	Homogeneous		100%	Binder	None Detected
A192818B		Gray				
		Non-fibrous				
		Bound				
WWI-30	Floor Tile	Homogeneous		100%	Vinyl	None Detected
A192819A		Blue				
		Non-fibrous				
		Bound				
A192819B	Sample Not Analyzed per COC					

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
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Date Received: 07-15-19
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Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
A192819C	Floor Tile	Homogeneous Green Non-fibrous Bound			90%	Vinyl	10% Chrysotile
A192819D	Mastic	Homogeneous Black Non-fibrous Bound			98%	Mastic	2% Chrysotile
WWI-31 A192820A	Ceiling Tile	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
A192820B	Mastic	Homogeneous Brown Fibrous Bound			98%	Mastic	2% Chrysotile
WWI-32 A192821A	Ceiling Tile	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
A192821B	Sample Not Analyzed per COC						
WWI-33 A192822	Drywall/Joint Compound	Heterogeneous Gray Fibrous Bound	15% 5%	Cellulose Fiberglass	65% 10% 5%	Gypsum Calc Carb Paint	<1% Chrysotile

Lab Notes: Joint compound contains <1% chrysotile. Overall sample contains <1% chrysotile.

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-34 A192823	Drywall/Joint Compound	Heterogeneous Gray Fibrous Bound	15% 5%	Cellulose Fiberglass	65% 10% 5%	Gypsum Calc Carb Paint	<1% Chrysotile
Lab Notes: Joint compound contains <1% chrysotile. Overall sample contains <1% chrysotile.							
WWI-35 A192824A	Floor Tile	Homogeneous Blue Non-fibrous Bound			100%	Vinyl	None Detected
A192824B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
WWI-36 A192825A	Floor Tile	Homogeneous Blue Non-fibrous Bound			100%	Vinyl	None Detected
A192825B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
WWI-37 A192826	Pinhole Ct	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected
WWI-38 A192827	Pinhole Ct	Heterogeneous White Fibrous Bound	60% 35%	Mineral Wool Fiberglass	5%	Paint	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
WWI-39 A192828	Sink Undercoating	Homogeneous White Non-fibrous Bound	60%	Cellulose	40%	Binder	None Detected
WWI-40 A192829	Sink Undercoating	Homogeneous White Non-fibrous Bound	60%	Cellulose	40%	Binder	None Detected
WWI-41 A192830A	Floor TIle	Homogeneous Cream Non-fibrous Bound			98%	Vinyl	**2% Chrysotile**
A192830B	Mastic	Homogeneous Black Non-fibrous Bound			92%	Mastic	**8% Chrysotile**
WWI-42 A192831A	Sample Not Analyzed per COC						
A192831B	Sample Not Analyzed per COC						
WWI-43 A192832A	Floor TIle	Homogeneous Olive Non-fibrous Bound			97%	Vinyl	**3% Chrysotile**
A192832B	Mastic	Homogeneous Black Non-fibrous Bound			95%	Mastic	**5% Chrysotile**
WWI-44 A192833A	Sample Not Analyzed per COC						

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
A192833B	Sample Not Analyzed per COC						
WWI-45 A192834	Textured Pinhole Ct	Heterogeneous White Fibrous Bound	60% 30%	Cellulose Fiberglass	5% 5%	Perlite Paint	None Detected
WWI-46 A192835	Textured Pinhole Ct	Heterogeneous White Fibrous Bound	60% 30%	Cellulose Fiberglass	5% 5%	Perlite Paint	None Detected
WWI-47 A192836A	Floor TIle	Homogeneous Gray Non-fibrous Bound			95%	Vinyl	**5% Chrysotile**
A192836B	Mastic	Homogeneous Black Non-fibrous Bound			95%	Mastic	**5% Chrysotile**
WWI-48 A192837A	Sample Not Analyzed per COC						
A192837B	Sample Not Analyzed per COC						
WWI-49 A192838A	Floor TIle	Homogeneous Cream Non-fibrous Bound			100%	Vinyl	None Detected
A192838B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
WWI-50 A192839A	Floor TIle	Homogeneous Cream Non-fibrous Bound		100%	Vinyl	None Detected
A192839B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
WWI-51 A192840A	Floor Tile	Homogeneous Blue,White Non-fibrous Bound		100%	Vinyl	None Detected
A192840B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
WWI-52 A192841A	Floor Tile	Homogeneous Blue,White Non-fibrous Bound		100%	Vinyl	None Detected
A192841B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
WWI-53 A192842A	Floor Tile	Homogeneous Cream Non-fibrous Bound		98%	Vinyl	**2% Chrysotile**

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	 Non-Fibrous	ASBESTOS %
A192842B	Mastic	Homogeneous Black Non-fibrous Bound	95%	Mastic	**5% Chrysotile**
WWI-54 A192843A	Sample Not Analyzed per COC				
A192843B	Sample Not Analyzed per COC				
WWI-55 A192844A	Floor Tile	Homogeneous Cream Non-fibrous Bound	95%	Vinyl	**5% Chrysotile**
A192844B	Mastic	Homogeneous Yellow Non-fibrous Bound	100%	Mastic	None Detected
WWI-56 A192845A	Sample Not Analyzed per COC				
A192845B	Mastic	Homogeneous Yellow Non-fibrous Bound	100%	Mastic	None Detected
WWI-57 A192846A	Floor Tile	Homogeneous Tan,White Non-fibrous Bound	90%	Vinyl	**10% Chrysotile**
A192846B	Mastic	Homogeneous Black,White Non-fibrous Bound	92%	Mastic	**8% Chrysotile**

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163
Date Received: 07-15-19
Date Analyzed: 07-16-19
Date Reported: 07-22-19

Project: WW Intermediate, 19-14.15

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
WWI-58 A192847A	Sample Not Analyzed per COC					
A192847B	Sample Not Analyzed per COC					
WWI-59 A192848A	Floor Tile	Homogeneous Green Non-fibrous Bound		97%	Vinyl	3% Chrysotile
A192848B	Mastic	Homogeneous Black Non-fibrous Bound		92%	Mastic	8% Chrysotile
WWI-60 A192849A	Sample Not Analyzed per COC					
A192849B	Sample Not Analyzed per COC					
WWI-61 A192850	Window Bedding	Homogeneous Gray Fibrous Bound		88% 10%	Binder Calc Carb	2% Chrysotile
WWI-62 A192851	Sample Not Analyzed per COC					
WWI-63 A192852	Window Caulking	Homogeneous White Non-fibrous Bound		100%	Caulk	<1% Chrysotile
WWI-64 A192853	Window Caulking	Homogeneous Black Non-fibrous Bound		100%	Caulk	<1% Chrysotile

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LEGEND: Non-Anth = Non-Asbestiform Anthophyllite
Non-Trem = Non-Asbestiform Tremolite
Calc Carb = Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REPORTING LIMIT FOR POINT COUNTS: 0.25% by 400 Points or 0.1% by 1,000 Points

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. *Estimated measurement of uncertainty is available on request.*

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: Ryan Steele

Ryan Steele

APPROVED BY:

Tianbao Bai, Ph.D., CIH
Laboratory Director

Megan Fisher

NVLAP TESTING
NVLAP LAB CODE 101768-0

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July 31, 2019

Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

CLIENT PROJECT: WW Intermediate, 19-14.15 (400 Point Count)
CEI LAB CODE: A1914163A

Dear Customer:

Enclosed are asbestos analysis results for PLM bulk samples received at our laboratory on July 25, 2019. The samples were analyzed for asbestos using polarized light microscopy (PLM) point count per the EPA 600 Method.

Sample results containing > 1% asbestos are considered asbestos-containing materials (ACMs) per the EPA regulatory requirements. The detection limit for the EPA 600 method is 0.25% for 400 point counts, or 0.1% for 1,000 point counts.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Mac Paran Consulting Services, Inc.

CLIENT PROJECT: WW Intermediate, 19-14.15 (400 Point Count)

LAB CODE: A1914163A

TEST METHOD: PLM Point Count
EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 07/31/19

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

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Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163A
Date Received: 07-25-19
Date Analyzed: 07-30-19
Date Reported: 07-31-19

Project: WW Intermediate, 19-14.15 (400 Point Count)

ASBESTOS POINT COUNT PLM, EPA 600 METHOD

Client ID	Lab ID	Material Description	POINTS Total	POINTS Asbestos	ASBESTOS %	
WWI-6	A192795	Roof Drain	400	0	**<0.25%**	**Chrysotile**
Lab Notes: Chrysotile detected below limit of quantitation.						
WWI-7	A192796	Roof Drain	400	0	**<0.25%**	**Chrysotile**
Lab Notes: Chrysotile detected below limit of quantitation.						

LEGEND: None

METHOD: EPA 600 / M4 / 82 / 020 (40 CFR Part 763, Sub. E, App. E)

REPORTING LIMIT: 0.25% by 400 points or 0.1% by 1,000 points

REGULATORY LIMIT: >1% by weight

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Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: Ryan Steele

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Megan Fisher

NVLAP TESTING
NVLAP LAB CODE 101768-0

August 22, 2019

Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

CLIENT PROJECT: WW Intermediate, 19-14.15 (400 Point Count)
CEI LAB CODE: A1914163C

Dear Customer:

Enclosed are asbestos analysis results for PLM bulk samples received at our laboratory on August 20, 2019. The samples were analyzed for asbestos using polarized light microscopy (PLM) point count per the EPA 600 Method.

Sample results containing > 1% asbestos are considered asbestos-containing materials (ACMs) per the EPA regulatory requirements. The detection limit for the EPA 600 method is 0.25% for 400 point counts, or 0.1% for 1,000 point counts.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Mac Paran Consulting Services, Inc.

CLIENT PROJECT: WW Intermediate, 19-14.15 (400 Point Count)

LAB CODE: A1914163C

TEST METHOD: PLM Point Count
EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 08/22/19

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

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Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163C
Date Received: 08-20-19
Date Analyzed: 08-21-19
Date Reported: 08-22-19

Project: WW Intermediate, 19-14.15 (400 Point Count)

ASBESTOS POINT COUNT PLM, EPA 600 METHOD

Client ID	Lab ID	Material Description	POINTS Total	POINTS Asbestos	ASBESTOS %	
WWI-33	A192822	Joint Compound (Point Count)	400	1	**0.25%**	**Chrysotile**
	A192822	Drywall/joint Compound (Composite Result From Point Count)	400		**0.013**	**Chrysotile**
Lab Notes: Joint compound is 5% of overall sample.						
WWI-34	A192823	Joint Compound (Point Count)	400	2	**0.50%**	**Chrysotile**
	A192823	Drywall/joint Compound (Composite Result From Point Count)	400		**0.025**	**Chrysotile**
Lab Notes: Joint compound is 5% of overall sample.						

LEGEND: None

METHOD: EPA 600 / M4 / 82 / 020 (40 CFR Part 763, Sub. E, App. E)

REPORTING LIMIT: 0.25% by 400 points or 0.1% by 1,000 points

REGULATORY LIMIT: >1% by weight

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Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: Ryan Steele

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Megan Fisher

NVLAP TESTING
NVLAP LAB CODE 101768-0

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July 31, 2019

Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

CLIENT PROJECT: WW Intermediate, 19-14.15 (Gravimetric Point Count)
CEI LAB CODE: A1914163B

Dear Customer:

Enclosed are asbestos analysis results for PLM bulk samples received at our laboratory on July 25, 2019. The samples were analyzed for asbestos using polarized light microscopy (PLM) gravimetric point count per the EPA 600 Method.

Sample results containing > 1% asbestos are considered asbestos-containing materials (ACMs) per the EPA regulatory requirements. The detection limit for the EPA 600 method is < 0.25% for gravimetric point count depending on the processed sample weight and points counted.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

Mac Paran Consulting Services, Inc.

CLIENT PROJECT: WW Intermediate, 19-14.15 (Gravimetric Point Count)

LAB CODE: A1914163B

TEST METHOD: PLM Gravimetric Point Count
EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 07/31/19

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: Mac Paran Consulting Services, Inc.
3959 Fulton Grove Rd.
Cincinnati, OH 45245

Lab Code: A1914163B
Date Received: 07-25-19
Date Analyzed: 07-30-19
Date Reported: 07-31-19

Project: WW Intermediate, 19-14.15 (Gravimetric Point Count)

ASBESTOS GRAVIMETRIC POINT COUNT PLM, EPA 600 METHOD

Client ID Lab ID	Material Description	Sample Weight (g)	Organic Material (%)	Acid Soluble Material (%)	Acid Insoluble Material (%)	ASBESTOS %	
WWI-63 A192852	Window Caulking (Gravimetric Point Count)	0.129	41	37	22	**0.22%**	**Chrysotile**
WWI-64 A192853	Window Caulking (Gravimetric Point Count)	0.18	41	34	25	**0.38%**	**Chrysotile**

LEGEND: None

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: Varies with the weight and constituents of the sample (<0.25%)

REGULATORY LIMIT: >1% by weight

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Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

ANALYST: Ryan Steele

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Megan Fisher

NVLAP TESTING
NVLAP LAB CODE 101768-0

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730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

CHAIN OF CUSTODY

64

LAB USE ONLY:
CEI Lab Code: A19141163
CEI Lab I.D. Range: A192790 - A192853

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact: Paul Cordy
Company: mac Paran	Email / Tel: Paul@macparan.com
Address: 3959 Fulton Grove RD	Project Name: WW Intermediate
Cincinnati, OH 45245	Project ID#: 19.14-15
Email: Paul@macparan.com	PO #:
Tel: 5137529111 Fax:	STATE SAMPLES COLLECTED IN:

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	1 DAY	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☐	☑
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600		☐	☐	☐	☐	☐
PLM BULK	CARB 435		☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR (PCME)	ISO 10312	☐	☐	☐	☐	☐	☐
TEM AIR	ASTM 6281-15	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD		☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05 (2010)	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09 (2014)	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-16			☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD			☐	☐	☐	☐
TEM QUALITTATIVE	IN-HOUSE METHOD		☐	☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:
POSITIVE STOP ANALYSIS

☒ Accept Samples
☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	7/12/19 1:03	[signature]	7/15 9:20

Samples will be disposed of 30 days after analysis

A1914163

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: Mac Paran	Job Contact: Paul Cordy
Project Name: WWI Intermediate	Paul@macparan.com
Project ID #: 19-14.15	Tel: 513-752-9111

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
WWI - 1	HARD Fitting Room 101	1	PLM ☐	TEM ☐
2	↓ ↓ Room 135D	1	PLM ☐	TEM ☐
3	↓ ↓ Room 129	1	PLM ☐	TEM ☐
4	Rope Gasket Room 129	2	PLM ☐	TEM ☐
5	↓ ↓ Room 129	2	PLM ☐	TEM ☐
6	Roof Drain Room 134	3	PLM ☐	TEM ☐
7	↓ ↓	3	PLM ☐	TEM ☐
8	12" Grey w/ blue FT/M	4	PLM ☐	TEM ☐
9	↓ ↓ ↓	4	PLM ☐	TEM ☐
10	2x4 FISSURED CT Room 139	5	PLM ☐	TEM ☐
11	↓ ↓ ↓ Room 142	5	PLM ☐	TEM ☐
12	Cove Base Mastic H108	6	PLM ☐	TEM ☐
13	↓ ↓ ↓ Room 106	6	PLM ☐	TEM ☐
14	Drywall	7	PLM ☐	TEM ☐
15	↓ ↓	7	PLM ☐	TEM ☐
16	9" Grey FT/M STAGE	8	PLM ☐	TEM ☐
17	↓ ↓	8	PLM ☐	TEM ☐
18	9" Olive Green FT/M Room 132	9	PLM ☐	TEM ☐
19	↓ ↓ ↓	9	PLM ☐	TEM ☐
20	RED MASTIC Room 134	10	PLM ☐	TEM ☐
21	↓ ↓ H105	10	PLM ☐	TEM ☐
22	HARD PLASTER Room 139B	11	PLM ☐	TEM ☐
23	↓ ↓ R-156	11	PLM ☐	TEM ☐
24	↓ ↓ R-151	11	PLM ☐	TEM ☐
25	↓ ↓ H104	11	PLM ☐	TEM ☐
26	↓ ↓ H105	11	PLM ☐	TEM ☐
27	↓ ↓ R-126	11	PLM ☐	TEM ☐
28	↓ ↓ R-140C	11	PLM ☐	TEM ☐

A1914163

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: mac Paran	Job Contact: Paul Cordis
Project Name: WWI INTERMEDIATE	
Project ID #: 19-14.15	Tel: 513-752-9111

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
WWI-29	9"Green FT/12"Blue R-147	12/13	PLM ☐	TEM ☐
30	↓ ↓ R-142	12/13	PLM ☐	TEM ☐
31	12" CT w/MASTIC R-146A	14	PLM ☐	TEM ☐
32	↓ ↓ ↓ R146B	14	PLM ☐	TEM ☐
33	Drywall/Joint Compound H101	15	PLM ☐	TEM ☐
34	↓ ↓ ↓ H201	15	PLM ☐	TEM ☐
35	12" FT/M R-140D	16	PLM ☐	TEM ☐
36	↓ ↓ ↓ R-140	16	PLM ☐	TEM ☐
37	Pinhole CT R-140	17	PLM ☐	TEM ☐
38	↓ ↓ R-140	17	PLM ☐	TEM ☐
39	Sink Undercoating R-140A	18	PLM ☐	TEM ☐
40	↓ ↓	18	PLM ☐	TEM ☐
41	12" Cream w/ black FT H105	19	PLM ☐	TEM ☐
42	↓ ↓ ↓ H102	19	PLM ☐	TEM ☐
43	12" Olive FT/M H108	20	PLM ☐	TEM ☐
44	↓ ↓ ↓ H102	20	PLM ☐	TEM ☐
45	Textured Pinhole CT H104	21	PLM ☐	TEM ☐
46	↓ ↓ H101	21	PLM ☐	TEM ☐
47	9"Grey w/ white FT/M R-115	22	PLM ☐	TEM ☐
48	↓ ↓ ↓ ↓ R-131	22	PLM ☐	TEM ☐
49	12"Cream w/ Brown FT R-105	23	PLM ☐	TEM ☐
50	↓ ↓ ↓ ↓ ↓	23	PLM ☐	TEM ☐
51	12" Blue w/ White FT/M R-114	24	PLM ☐	TEM ☐
52	↓ ↓ ↓ ↓ R-110A	24	PLM ☐	TEM ☐
53	9" CREAM w/ WHITE FT/M	25	PLM ☐	TEM ☐
54	↓ ↓ ↓ R-110B	25	PLM ☐	TEM ☐
55	12"Cream w/ Black FT/M H110	26	PLM ☐	TEM ☐
56	↓ ↓ ↓ ↓ ↓	26	PLM ☐	TEM ☐

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: mac Paran	Job Contact: Paul Cordy
Project Name: WW Intermediate	
Project ID #: 19-14.15	Tel: 513 752 9111

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
WWI - 57	9" Tan w/ White FTM R-28	27	PLM ☐	TEM ☐
58	↓ ↓ ↓ ↓ R-29	27	PLM ☐	TEM ☐
59	12" Green w/ black FTM H201	28	PLM ☐	TEM ☐
60	↓ ↓ ↓ ↓ H201	28	PLM ☐	TEM ☐
61	WINDOW BEDDING R-111	29	PLM ☐	TEM ☐
62	↓ ↓ R-131	29	PLM ☐	TEM ☐
63	WINDOW CAULKING		PLM ☐	TEM ☐
64	↓ ↓		PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
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Appendix B

Asbestos Hazard Evaluation Specialist License

Ohio Environmental Protection Agency

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

November 26, 2018

Paul A Cordy
MAC Paran Consulting
3959 Fulton Grove Rd
Cincinnati OH 45245

RE: Asbestos Hazard Evaluation Specialist
Certification Number: ES34509
Expiration Date: 11/14/2019

Dear Paul A Cordy:

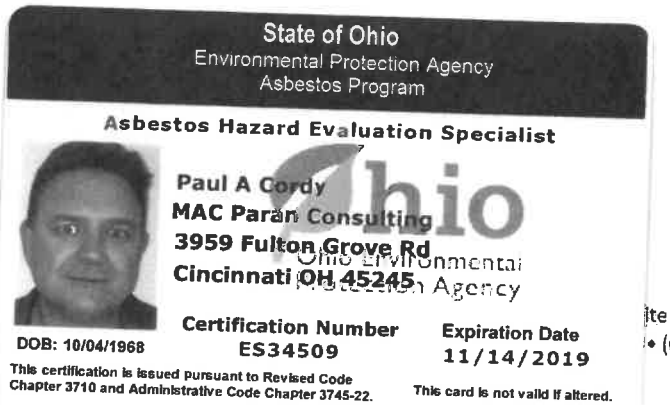
This letter and enclosed certification card approves your request to be certified as an Asbestos Hazard Evaluation Specialist. You must present your card upon request at any project site while performing duties. Copies of cards are not acceptable as proof of certification.

This certification may be revoked by the Director of the Environmental Protection Agency for violation of any of the requirements of 3745-22 or 3745-20 of the Ohio Administrative Code.

If you have any questions, please call 614-644-0226.

Sincerely,

Mark Needham
Manager, Asbestos Program
Division of Air Pollution Control


State of Ohio
Environmental Protection Agency
Asbestos Program

Asbestos Hazard Evaluation Specialist

Paul A Cordy
MAC Paran Consulting
3959 Fulton Grove Rd
Cincinnati OH 45245

DOB: 10/04/1968

Certification Number
ES34509

Expiration Date
11/14/2019

This certification is issued pursuant to Revised Code Chapter 3710 and Administrative Code Chapter 3745-22.

This card is not valid if altered.

ite 700 • P.O. Box 1049 • Columbus, OH 43216-1049
• (614) 644-3020 • (614) 644-3184 (fax)

Appendix C

Universal/Hazardous Waste Materials Inventory

Winton Woods Intermediate School
Universal/Hazardous Waste Inventory

Item	Quantity
4’ Fluorescent Bulbs	2,690
8’ Fluorescent Bulbs	8
Fluorescent Ballasts	672
Compact Fluorescent Lamp Bulbs	86
U Shaped Bulbs	14
Water Fountains with Chlorofluorocarbons	7
Exit Sign Batteries	24
Window Mounted Air-Conditioning Units	34
Roof Air-Conditioning Units	6

NOTE: The information provided is for reference purposes only. The Contractor is responsible for the actual inventory of materials to be removed.

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete masonry units (CMU) standard types.
2. Clay Face Brick.
3. Mortar.
4. Grout.
5. Steel reinforcing bars.
6. Masonry joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.
10. Masonry cleaners.

B. Related Requirements:
1. Section 07 92 00 "Joint Sealants" for sealing control and expansion joints in unit masonry.

C. Products furnished, but not installed, under this Section include the following:
1. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Section 05 12 00 "Structural Steel Framing."

D. Products installed, but not furnished, under this Section include the following:
1. Steel lintels for unit masonry, furnished under Section 05 50 00 "Metal Fabrications."
2. Sheet metal flashing installed in association with masonry, furnished under Section 07 71 00 "Roof Specialties."
3. Hollow-metal frames in unit masonry openings, furnished under Section 08 11 13 "Hollow Metal Doors and Frames".

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted vertical and horizontal CMU cells.

1.3 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in TMS 602/ACI 530.1/ASCE 6.

B. Wherever an exterior masonry wall system includes a cavity 4-3/4-inches wide or greater provide Professional Engineer certification for the state of Ohio that the adjustable two-piece veneer tie system (adjustable ties and cross tabs, and any other veneer tie component) is sized and spaced to withstand a 90 mph, component in cladding wind load across the actual masonry cavity width of the Project.
1. Comply with design requirements of TMS 402 Chapter 6.

1.4 ACTION SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified. Include structural properties of precast masonry lintels.

B. Shop Drawings: For the following:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls, including reinforcement for bond beams.
2. Fabricated Flashing: Detail flashing installation details, formed corner units, formed end-dam units, and other special applications.

C. Samples for Initial Selection:
1. Weep holes/vents; actual units showing full range of colors available.
2. Colored mortar samples showing the full range of colors available but not less than (50) fifty.

1.5 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Dated, signed and sealed delegated design engineer calculations for masonry ties when required by Performance Requirements article in this Section.

D. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
1. Masonry units.
a. Include material test reports substantiating compliance with requirements.
b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
d. For masonry units used, include data and calculations establishing average net-area compressive strength of units.

E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in TMS 602/ACI 530.1/ASCE 6.

G. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Delegated Design Engineer: Experienced structural engineer licensed to practice in the State where the Project is located.

C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including colored mortar for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

E. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6.unless modified by requirements in the Contract Documents.

F. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
1. Protect concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

C. Store packaged cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store masonry sand on protective membrane that separates sand from the ground moisture and contaminants and does not retain water.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

F. Protect foam-plastic insulation as follows:
1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
3. If covering is temporarily removed to perform certain wall operations (such as air barrier / insulation installation) restore complete covering as soon as operations are complete and at end of workday; allow NO water intrusion into the masonry or the cavity.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work or will impair the quality of completed masonry.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners, unless otherwise indicated.

C. Manufacturers for standard CMU: Subject to compliance with requirements provide products by industry recognized regional manufacturer with production capabilities that ensure availability of all required standard sizes, special shapes and precast CMU lintels and delivery to the jobsite in compliance with the Project Schedule.

D. Standard CMUs: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Provide lightweight, maximum density not more than 105 lbs. per cubic foot, typical throughout building for interior work including the CMU wythe in exterior cavity walls.
a. Provide normal weight for below grade work and work exposed to the exterior.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
5. At time of delivery to jobsite, linear shrinkage of units shall not exceed 0.065%.

2.3 CONCRETE AND MASONRY LINTELS

A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated.
1. Provide concrete lintels where shown and where openings of more than 12 inches for block units are shown without structural steel or other supporting lintels.
2. Lintels shall obtain f'c = 4,000 psi at 28 days. Reinforcement shall comply with ASTM A 615, grade 60.

B. Masonry Lintels: Built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

C. Provide minimum bearing of 8 inches at each jamb, unless greater bearing is indicated.

2.4 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

B. Clay Face Brick: ASTM C 216, Grade SW, Type FBS unless otherwise noted.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi.
2. Initial Rate of Absorption: Less than 20 g/30 sq. in. per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Brick shall be a minimum 75 percent solid, unless noted otherwise on Drawings.
5. Size (Actual Dimensions): Same as adjacent existing brick.
6. Brick selections for all brick types must be made using the same brick manufacturer.
7. Acceptable manufacturers:
   a. Belden
   b. Glen-Gery Brick
   c. Interstate Brick
   d. Contienetal Brick Company

2.5 MORTAR FOR UNIT MASONRY

A. Masonry Cement: ASTM C91.
1. Subject to compliance with requirements, provide one of the following:
   a. Cemex S.A.B. de C.V.; Richmortar.
   b. Essroc, Italcementi Group; Brixment.
   c. LafargeHolcim; Masonry Cement.
   d. Lehigh Hanson HeidelbergCement Group; Lehigh Masonry Cement.
2. Aggregate for Mortar: Masonry sand, ASTM C 144.
3. Mortar Mixing: Provide one of the following mortar mixes.
   a. Add masonry cement to mixer in full bag quantities. Measure dry masonry sand in box with volume of one cubic foot as often as necessary to maintain consistent proportions and at least once daily and every 4 hours of mixing. Add water and mix for 3-5 minutes.
   b. Add preblended, dry mortar mix to the mixer. Furnish dry mortar ingredients (masonry cement and sand) in form of a preblended mix, ASTM C1714. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site. Add water and mix for 3-5 minutes.
4. Application: Provide for all cmu work and where non-pigmented mortar is required.

B. Colored Masonry Cement: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Subject to compliance with requirements, provide one of the following:
   a. Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
   b. Essroc, Italcementi Group; Flamingo-Brixment.
   c. LafargeHolcim; Custom Color Masonry Cement.
2. Pigments shall not exceed 5 percent of masonry cement by weight.
3. The Architect will select two (1) grey-based cement mortar color.
   a. Manufacturer of colored masonry cement shall submit a minimum of fifty (50) colors for selection by the Architect.
4. Aggregate for Mortar: Masonry sand, ASTM C 144.
5. Mortar Mixing: Provide one of the following mortar mixes.
   a. Add packaged colored masonry cement blend to mixer in full bag quantities. Measure dry masonry sand in box with volume of one cubic foot as often as necessary to maintain consistent proportions and at least once daily and every 4 hours of mixing. Add water and mix for 3-5 minutes.
   b. Add preblended, dry mortar mix to the mixer. Furnish dry mortar ingredients (packaged colored masonry cement and sand) in form of a preblended mix, ASTM C1714. Measure

quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site. Add water and mix for 3-5 minutes.

6. Application: Provide for all brick work.

C. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Use of cold-weather admixtures in mortar is not a substitution for compliance with TMS 602/ACI 530.1/ASCE 6 cold weather construction requirements
2. Cold-weather admixture (if used) shall be factory blended into the mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
3. Products: Subject to compliance with requirements, provide one of the following:
   a. Euclid Chemical Company (The); Accelguard 80.
   b. GCP Applied Technologies; Morset.
   c. BASF Construction Chemicals; Trimix-NCA.
   d. Spec Mix Inc.; Spec Mix Non-Chloride Accelerator.

D. Water: Potable.

E. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated:

LOCATION	BUILDING SEGMENT	MORTAR TYPE
Exterior, above grade	Load-bearing wall Non load-bearing wall Parapet and veneer wall	S N N
Exterior, at or below grade	Foundation wall, retaining wall, manholes, sewers, pavements, walks and patios	S
Interior, above grade	Load-bearing wall Non load-bearing partitions	N N
Interior, at or below grade	Foundation wall, retaining wall	S

2.6 GROUT FOR UNIT MASONRY

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in grout.

B. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout that has been factory pre-blended and delivered to project site.
   a. On-site field mixing of Portland cement and fine or coarse aggregate will NOT be permitted.
2. Use grout that will comply with Table 7 of TMS 602/ACI 530.1/ASCE 6. Use fine grout in grout spaces less than 2 inches in horizontal dimension, unless otherwise indicated.
3. Use coarse grout in grout spaces 2 inches or more in least horizontal dimension. Coarse grout shall be used for filling bond beams and for grouting cores of CMU with reinforcing bars.
4. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 3000 psi nor more than 5000 psi.
5. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

C. Aggregate for Grout: ASTM C 404.

D. Water: Potable.

2.7 REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

B. Uncoated Steel Reinforcing Bars: ASTM A 615or ASTM A 996, Grade 60.

C. Masonry Joint Reinforcement, General: ASTM A 951.
1. Hot-dip galvanized, carbon steel.
2. Wire Size for Cross Rods and Side Rods: W1.7 or 0.148-inch diameter.
3. Wire Size for Cavity Adjustable Tie and Cross Tabs: Minimum W2.8 or 0.188-inch diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c. each way and closer on center surrounding all openings.
5. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

D. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods and cross rods spaced not more than 16 inches o.c.

E. Masonry Joint Reinforcement for Multiwythe Masonry:
1. For multiwythe **composite CMU** walls: Ladder type with perpendicular cross rods spaced not more than 16 inches on center and 1 side rod for each face shell of CMU masonry.
2. For **composite Masonry Veneer / CMU** walls: 3-wire ladder type with perpendicular cross rods spaced not more than 16 inches on center and with pair of side rods spaced for embedment within each face shell of backup wythe, and one side wire spaced for embedment in the masonry veneer wythe. Size reinforcement to extend at least halfway through masonry veneer wythe but with at least 5/8-inch cover on outside face.
3. For **Masonry Veneer / CMU cavity** walls: Adjustable (2-piece) type with single pair of side rods, and cross tabs spaced not more than 16 inches o.c. and with separate adjustable ties engaging the cross tabs.
   a. Adjustable ties and cross tabs shall be rectangular and 0.188-inch diameter minimum. Space side rods for embedment within each face shell of CMU wythe and size adjustable ties to extend at least halfway through masonry veneer wythe but with at least 5/8-inch cover on outside face. Assembly shall provide 100% protection against separation of adjustable ties from cross tabs and shall not allow the adjustable ties to be installed beyond allowable eccentricity.
   b. Products: Subject to compliance with requirements including size and spacing strength design of the delegated design engineer, provide one of the following:
      Blok-Lok; BL-42 with System 2000 Adjustable Tie.
      Hohmann and Barnard, Inc.; Catalog No. 265 Ladder Style with Winged Loops and Pintles.
      Wire-Bond; Series 600 Ladder Type with Adjustable Tab.

2.8 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this Section that are made from materials that comply with subparagraphs below, unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153.

B. Actual size and spacing of all ties where cavity exceeds 4-3/4-inches shall be as determined by the delegated design engineer as required in Part 1 “Performance Requirements” of this Section.

C. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
2. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from minimum 0.188-inch-diameter, hot-dip galvanized steel wire. Where column web ties are indicated, provide 1/4-inch diameter x 12-inches long ties made from hot-dip galvanized steel.

D. Adjustable Masonry-Veneer Anchors for Connecting to Cold-Formed Metal Framing:
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to cold-formed metal framing (CFMF) studs, and as follows:
   a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

a. Products: Subject to compliance with requirements, provide one of the following:
Hohmann & Barnard, Inc.; X-Seal Anchor, Vee Byna-Tie.
Sandell Manufacturing Co., Inc.; VAX Anchor with VA Dovetail Tie.
Wire-Bond; Type III-x Anchor, #1100 Triangle tie.

b. Anchor Section: Sheet metal plate fabricated from 14 gauge steel sheet, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom, top and bottom ends bent to form pronged legs of length to match thickness of insulation and sheathing; and raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie, hot-dip galvanized after fabrication.
Provide anchor manufacturer's standard, self-adhering tape, compatible with insulation, and manufactured to fit behind anchor plate and extend beyond pronged legs.

c. Wire Ties: Triangular-wire ties fabricated from minimum 0.187-inch- diameter, hot-dip galvanized steel wire.

3. Polymer-Coated cadmium-plated Steel Drill Screws for CFMF Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange with not less than 3 exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

E. Partition Top anchors: As detailed on the drawings.

2.9 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.

B. Postinstalled Anchors: Provide chemical anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
2. Adhesive: Two-component, formulated to include resin, hardener, cement and water to provide optimal curing speed as well as high strength and stiffness.
3. Products: length as indicated or required; 3/8-inch minimum diameter.
a. Hilti, Inc. “HIT HY 70”.
b. Red Head “Epcon A7 Acrylic Adhesive”.
c. Powers Fasteners “AC100+ Gold Acrylic Adhesive.
4. Provide umbrella inserts where recommended by the manufacturer for use in hollow-core CMU.

2.10 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: For flashing not exposed to the exterior, use the following:
1. Self-Adhering, Non-asphaltic, Copper-Laminated Flashing: 3-oz./sq. ft. copper sheet bonded with adhesive between 2 layers of glass-fiber cloth; adhesive-backed with removable release liner. Use only where flashing is fully concealed in masonry.
a. Product: Subject to compliance with requirements, provide products by one of the following:
Advanced Building Products; Copper Sealtite 2000.
Hohmann & Barnard, Inc.; Copper-Tuff SA.
York Manufacturing; Multi-Flash 500.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

C. Metal Termination Bars: Predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Wire Mesh Ties: 1/2-inch mesh, 16 gage steel wire, hot dip galvanized.

B. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

C. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

D. Bond-Breaker Strips: Dense neoprene rubber (ASTM D-2000, Grade BC610) bearing pad; 1/8-inch thick. Use at steel wide flange beam and precast masonry lintel bearing end coinciding with control joint location.

E. Weep Products: Use the following unless otherwise indicated:
1. Cellular Plastic Weep: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, 3/8 inch width by 3-1/2 inch height and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
a. Products: Subject to compliance with requirements, provide one of the following:
Advanced Building Products Inc.; Mortar Maze weep vent.
Heckmann Building Products Inc.; No. 85 Cell Vent.
Hohmann & Barnard, Inc.; Quadro-Vent.
Wire-Bond; Cell Vent.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
c. Wire-Bond; #3401 Figure 8 or #3402 Double Figure 8.

G. Injection Adhesive Anchor: Injectable adhesive shall be used for installation of reinforcing steel dowels into concrete, ONLY when doweling into footing was not completed per plan or misaligned.
1. Adhesive: two-component, formulated to include resin, hardener, cement and water to provide optimal curing speed as well as high strength and stiffness.
2. Products:
a. Hilti, Inc. “HIT HY 200 Max”.
b. Red Head “Epcon A7 Acrylic Adhesive”.
c. Powers Fasteners “AC100+ Gold Acrylic Adhesive”.

2.12 MASONRY CLEANERS

A. Proprietary Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COORDINATION OF THRU-WALL RECEIVER AND COUNTER FLASHING

A. Coordinate locations of thru-wall receiver and counter flashing as indicated in Section 07 71 00 well in advance of performing masonry work where this flashing is indicated.
1. Joint elevation for thru-wall receiver and counter flashing as determined by procedures of Section 07 71 00 may supersede elevations and joints indicated on drawings.

B. Receive and install thru-wall receiver specified in Section 07 71 00.

3.3 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
1. Mix units from several pallets or cubes as they are placed.

F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.4 TOLERANCES

A. Comply with construction tolerances in TMS 602/ACI 530.1/ASCE 6 and with the following:
1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet1/4 inch in 20 feet or 1/2 inch maximum.
2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2 inch maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet1/4 inch in 20 feet or 1/2 inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.5 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
1. Do not use units with less than nominal 4-inch horizontal face dimension.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in the following bond patterns:
1. Exterior brickwork: One-third running bond.

2. Interior CMU walls: Standard running bond.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items whether or not specifically so detailed. Provide clearance at structural members and metal deck as indicated below.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
1. Maintain a one inch joint between partition and penetrating structural framing. Install compressible filler in joint between top of partition and underside of structure above.
2. Laterally brace partitions with steel angle restraints as detailed.
3. At fire-rated and smoke-rated partitions, treat joint between top of partition and underside of structure above and between partitions and penetrating structural framing to comply with Drawings.

J. Grout solid all cores of CMU below floor line, and grout solid all collar joints in CMU work below floor line, whether indicated on details or not.

K. Ease the exterior corners of all CMU walls and partitions in occupied rooms and corridors, by rubbing with an abrasive stone, removing sharp corners and providing an approximate 1/4-inch radius.

3.6 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
1. Strike mortar joints flush at brick where Drawings indicate “Masonry Veneer – Type 5”.

D. Cut joints flush for masonry walls to receive direct-applied finishes (other than paint) unless otherwise indicated.

3.7 CAVITY WALLS

A. Bond wythes of cavity walls together using:
1. Masonry Joint Reinforcement: Installed in horizontal CMU mortar joints.
2. See Anchoring Masonry Veneers Article in this Section. Use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.

B. Seal expansion, control and building control joints in the CMU wythe of cavity walls on the interior room face, full height – slab to underside of deck above, including all above-ceiling portions of the joint and joints concealed in a pipe chase or similar inaccessible space**.**

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Strike mortar joints flush with cmu.

D. Seal all openings between cavity and building interior with masonry, mortar, sealant or tightly-packed mineral-fiber insulation (in that order of preference). Maintain clearances with structural members as specified above and fill openings with mineral-fiber insulation.
1. Any structural tube sections penetrating cavity walls shall have tightly packed mineral fiber insulation at least 6-inches thick to plug the interior of the member against air movement.

3.8 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners by using prefabricated L-shaped units.

D. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, and other special conditions.

3.9 TIEING MASONRY TO STRUCTURAL MEMBERS

A. Tie masonry to structural members where masonry abuts or faces structural members to comply with the following:
1. Provide an open space between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to each face of structural members with 1/4-inch diameter weld-on anchor rods and 3/16-inch diameter triangular ties at 16-inch vertical and 24-inch horizontal spacing whether or not indicated on the Drawings.

3.10 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to CFMF stud walls with masonry-veneer anchors to comply with the following requirements:
1. Connecting to CFMF stud walls: Fasten screw-attached anchors through sheathing and insulation to wall framing with metal fasteners of type indicated.
2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

3.11 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry units as follows:
1. Install preformed control-joint gaskets designed to fit standard sash block.
2. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete and ready for sealant specified in other sections. Filler and sealant shall extend full height of interior face of cavity wall CMU wythe regardless of ceiling height.

C. Form expansion joints in brick made from clay as follows:
1. Form open joint of width indicated for installation of expanding foam sealant specified in Section 07 92 00 "Joint Sealants." Keep joint free and clear of mortar.

3.12 LINTELS

A. Install steel lintels where indicated.

B. Where lintels occur at masonry control joints, place bond breaker at bearing; hold back bond breaker 1/2-inch from opening and face of wall. Rake out mortar at lintel 1/2-inch for sealant application.

3.13 FLASHING, WEEP HOLES, AND CAVITY DRAINAGE

A. General: Install embedded flashing, cavity drainage material, and weep holes in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Provide special lipped or saw-cut masonry veneer below lintel where necessary to maintain consistent mortar joint height dimension.

C. Install flashing as follows, unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Allow no penetrations through flashings. Coordinate in advance with all trades to ensure placement of all wall-penetrating work to be above or below flashings. Do not flash and/or seal around such items if discovered when installing flashings; notify Architect and have such work relocated.
3. At multiwythe masonry walls, including cavity walls, install flashing as indicated on the drawings and any other interruption in the downward flow of moisture in the cavity, Provide weeps and cavity drainage material at all across-cavity flashings.
4. At wall caps and under copings install continuous single width membrane flashing full thickness of wall; turn down face if concealed or provide drip edge if exposed.
5. Under sills of aluminum windows, storefront and curtainwall systems install membrane flashing from inside edge of aluminum member to outside face of masonry (or slab), or extent of substrate concealed by the aluminum sill.
6. In cavities including behind brick veneer, turn flashing up substrate surface at least 8-inches (higher if recommended by the manufacturer) then terminate and seal top of flexible flashings and mechanically anchor to substrate through termination bars.
7. At lintels, extend flashing full length of lintel bearing into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
8. Special condition for flashing of walls above adjacent roof, roof edges and parapets:
   a. Extend all through-wall flashings located above roof lines at least 6-inches beyond the roof edge and not less distance than the projection of roof edge metal trim, fascia, coping, or gutter.
   b. Overlap flashing steps 6-inches minimum.
   c. Do not terminate through wall flashings or provide a flashing step at inside or outside wall corners; wrap around corners at least 6-inches.
   d. At abutting parapet walls, step through-wall flashings around and above parapet in a manner that enables proper roof membrane flashing and termination.
9. Roll overlaps in self-adhering membrane flashings with 2-inch wide neoprene roller and firm pressure to ensure proper adhesion of the lap.
10. Prime surfaces of substrates to receive self-adhered membrane flashings if flashing manufacturer indicates in their literature this operation will produce superior bonding of the membrane to the substrates indicated for the project. Do not spread bonding agents onto insulation.
11. At openings in cavity walls, extend air barrier flashings continuously from face of insulation to interior face of fenestration systems.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use weep types in locations as indicated in Part 2.
2. Space weep holes maximum 32 inches on center.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.14 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction. Above windows and doors limit deflection of formwork and shores to 1/16-inch.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement.
2. Limit height of vertical grout pours to not more than 56 inches.

3.16 INJECTION ADHESIVE ANCHOR INSTALLATION

A. Only injection tools and static mixing nozzles as recommended by manufacturer shall be used. Comply with manufacturer’s instructions and recommendations.

3.17 FIELD QUALITY CONTROL

A. **Contractor’s Performance Testing:** Water-test cavity to verify all water is draining to the exterior through the weeps before continuing with exterior wythe or capping wall.
1. Perform tests in presence of Owners Agent, Architect, and testing agency representative. Representative of general contractor and masonry contractor must be in attendance and perform the test. Provide at least 5-days advance notice of time a scheduled test will be performed.
2. Perform tests at locations selected by the Architect. At least three tests will be required. At least one test will be at an above-roof location. Architect may require an additional unscheduled next-day test at any time, after flashing is placed and veneer above flashing is just starting; regardless of unanticipated interruption of veneer work, comply with test procedures.
3. Test Procedures:
   a. Extend veneer wythe 8-inches minimum and 12-inch maximum, above flashing to perform test.
   b. Hold water hose and continuously discharge at standard water pressure force into the cavity at a cell vent so that water can be observed discharging from adjacent weeps for a period of five minutes minimum.
   c. Continue down the wall to the next cell vent where water has not been observed discharging and repeat the test for the same time period.
   d. Continue repeating this process until entire flashing length has been tested and passed.
   e. Photo-document the testing in compliance with Division 01 Section “Photographic Documentation”. Permit and assist other test observers to photograph test.
   f. Water observed inside the building, or water outside the building at locations other than at weeps will constitute a test failure.
4. In event of test failure, remove the masonry veneer down to the flashing, inspect and repair or replace the flashing, relay veneer to required test-height and re-perform the water test.
5. Failure of one test location will mandate higher frequency and number of tests to be performed at no additional cost to Owner or others.

B. **Testing and Inspecting**: Contractor will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

C. Inspections: Level 1 special inspections according to the "Ohio Building Code."
1. Payment for these services will be made by ***Contractor***.

2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for compressive strength.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.18 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.19 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions including empty openings and openings containing penetrating items. Requirements apply to ALL trades.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:
1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. 3M Fire Protection Products.
      b. Hilti, Inc.
      c. Specified Technologies, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
   2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
   3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
   1. Sealant shall have a VOC content of 250 g/L or less.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

D. Install fill materials by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use

mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 07 84 13

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Urethane joint sealants.
2. Immersible joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

B. Related Requirements:
1. Section 03 30 00 “Cast-in-Place Concrete” for sealant installed in control joints in rooms designated to have exposed, sealed concrete floors.
2. Section 07 91 00 "Preformed Joint Seals" for preformed compressible foam joint seals.
3. Section 07 92 19 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.
4. Section 32 13 13 "Concrete Paving" for sealing joints in walkways and curbing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer.

B. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 URETHANE JOINT SEALANTS

A. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.
1. Applications:
a. Exterior joints in vertical and overhead surfaces including:
1) Control joints in unit masonry;
2) Window, door frame, storefront, and louver perimeter joints (both interior and exterior side of opening).
3) Perimeter of DEFS soffits where they abut another material.
4) All other exterior non-traffic joints not included otherwise.
b. Interior joints in vertical and overhead surfaces including;
1) Control joints on exposed interior surfaces of exterior walls (both above and below ceilings);
2) Perimeter joints of exterior openings;
3) Control joints on exposed unit masonry walls.
2. Products: Subject to compliance with requirements, provide one of the following:
a. Pecora Corporation; DynaTrol II.
b. Tremco Incorporated; Dymeric 240.
3. Color Selection Range: Standard or custom colors providing minimum wide-range selection from at least 50 choices.

2.3 IMMERSIBLE JOINT SEALANTS

A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C 1247, Class 1; tested in deionized water unless otherwise indicated

B. Urethane, Immersible, M, NS or P, 25, T, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Uses T, NT, and I.

1. Applications:
   a. Interior joints in horizontal traffic surfaces including tile control and expansion joints,
   b. All other interior traffic joints not included otherwise.
2. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Building Systems; MasterSeal NP 2.
   b. Pecora Corporation; DynaTred.
   c. Sika Corporation U.S., Construction Products Division; Sikaflex 2c NS.
   d. Tremco Incorporated; Dymeric 240 FC.
3. Color Selection Range: Standard or custom colors providing minimum wide-range selection from at least 50 choices.

2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Applications: Interior joints in vertical surfaces of:
   a. Ceramic tile
   b. Non-porous surfaces in areas of moisture and high humidity including toilet rooms, showers and kitchens;
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Dow Corning Corporation; 786 Silicone Sealant.
   b. Momentive; GE Sanitary SCS1700.
   c. Pecora Corporation; 898NST.
   d. Tremco Incorporated; Tremsil 200 Sanitary.

2.5 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
1. Applications:
   a. Bedding thresholds to concrete at exterior door locations.
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Bostik, Inc.; Chem-Calk 300.
   b. Pecora Corporation; BC-158.
   c. Tremco Incorporated; Tremco Butyl Sealant.

2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Applications:
   a. Interior vertical and overhead surfaces at perimeter of wall surfaces and frames of interior doors and borrowed lights.
   b. Perimeter of gypsum board surfaces where they abut another material.
   c. Perimeter joints between interior wall surfaces and countertops, backsplashes, fixed equipment, and other elements to produce a finished, cleanable, craftsman-like appearance.
   d. All other interior nontraffic joints not included otherwise.
2. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Building Systems; Sonolac.
   b. Bostik, Inc.; Chem-Calk 600.
   c. Pecora Corporation; AC-20 +Silicone.
   d. Tremco Incorporated; Tremflex 834.

2.7 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint configuration per Figure 8A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Contract Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Standard hollow metal doors and frames.
2. Standard hollow metal door frames with integrated electrical conduit / wiring pathways (E-frames).

B. Related Requirements:
1. Section 04 20 00 "Unit Masonry" for installing anchors and grouting frames in masonry construction.
2. Section 08 71 10 "Door Hardware" for door hardware and weather stripping for hollow metal doors and frames.
3. Section 08 80 00 “Glazing” for glass in glazed openings in hollow metal doors and frames.
4. Section 09 91 12 "Painting" for field painting factory-primed hollow metal doors and frames.
5. Division 26 Section “Electrical” for coordination with electrified hardware.
6. Division 27 Section “Technology” for coordination with access control system.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:
1. Elevations of each door design and each frame type.
2. Individual details of each differing E-Frame configuration.
a. Include details of conduit, boxes, and preparations for power, signal, and control systems.
3. Details of doors, including vertical and horizontal edge details and metal thicknesses.
4. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
5. Locations of reinforcement and preparations for hardware.
6. Details of anchorages, joints, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide hollow metal doors and frames designated on drawings as “HM” by one of the following:
1. Ceco Door Products; an Assa Abloy Group Co.
2. Curries Company; an Assa Abloy Group Co.
3. Daybar Industries Ltd.
4. Pioneer Industries, Inc.
5. Republic Doors and Frames.
6. Security Metal Products Corp. an Assa Abloy Group Co.
7. Steelcraft; an Allegion company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Provide all hollow metal doors receiving electrified hardware with conduit for field wiring of door by door hardware supplier.

C. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A.
1. Doors:
a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.053 inch.
d. Edge Construction: Model 2, Seamless.
e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
f. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
2. Frames:
a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch.
b. Construction: Face welded.
3. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Provide all hollow metal doors receiving electrified hardware with conduit for field wiring of door by door hardware supplier.

C. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A.
1. Doors:
a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
d. Edge Construction: Model 2, Seamless.

e. Core: Vertical steel stiffener.
1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

2. Frames:
a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
b. Construction: Face welded.

3. Exposed Finish: Prime.

2.5 E-FRAME REQUIREMENTS

A. Special shop-performed frame preparation is required for openings that have electric hardware, technology devices or security devices. These frames are defined as “E-Frames” on the drawings and in these specifications.

B. E-Frames: Fabricate all exterior hollow metal frames, and designated interior hollow metal frames, with integrated electrical junction boxes, conduit / wiring pathways as indicated on the drawings except as modified by paragraph ‘C’ below.
1. Conduit shall be 1/2” diameter conduit to connect between junction boxes. PVC conduit may be used if desired to assist in tight-bend conditions. Provide nylon pull string through all conduit between all junction boxes.
2. Fabricate all electrical junction boxes with knockouts on each face of each junction box cover plate for field connection of electrical conduit by electrician.
3. All components shall be securely fastened to the frame and placed to not inhibit correct placement and installation of the frame. Provide specialty jamb anchors if necessary.
4. Provide frame opening access to all junction boxes and provide flush cover plate and screws at each.

C. Coordination with Hardware and Equipment: Back-box sizes and locations indicted in the drawing E-frame details are developed from individual manufacturer product information and may not conform to space and location requirements of the specific products to be used in this Project. Frame fabricator shall:
1. Obtain specific product information for all electric door hardware and devices to be used at each opening. This includes but is not limited to electric strikes, power transfers, door operators, magnetic locks, and door position switches.
a. Verify that information gives specific frame-location requirements.
b. Verify that information gives specific mounting screw locations and requirements, cover-plate information and other provisions needed for attachment.
c. Verify that information includes specific physical dimensions. Alternatively, have Construction Manager furnish physical samples of each device clearly labeled for type and purpose; return to Construction Manager when no longer needed.
2. Prepare shop drawings that show frames with back-boxes of appropriate length, width and depth and proper location, connecting conduit of appropriate size, and lead-out conduit of appropriate location, size and length.
a. Boxes must accommodate space required to make wiring connections.
b. Prepare a separate frame detail and designation for each differing configuration of E-Fame components.
3. Fabricate frames after satisfactory review of shop drawings. For devices where a physical sample was received, perform a trial-test installation in the first-completed frame to ensure devices fit and can be properly installed.

2.6 FRAME ANCHORS

A. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. At frames with integrated electrical conduit / wiring pathways, provide jamb anchor type that does not interfere with conduit and box components.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.7 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

G. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

H. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.8 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:
1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection ratings indicated.
3. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
8. Glazed Lites: Factory cut openings in doors.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
      1) Three anchors per jamb from 60 to 90 inches high.
      2) Four anchors per jamb from 90 to 120 inches high.
      3) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
   b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Four anchors per jamb from 60 to 90 inches high.
      2) Five anchors per jamb from 90 to 96 inches high.
      3) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      4) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
8. Integrated electrical junction boxes, conduit / wiring pathways for hollow metal E-frames shall be fully assembled in the factory and provided with nylon pull string through all conduit between all junction boxes.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
3. For all E-frames, shop-fit frames with conduit system providing internal boxes for wiring installation to all current or potential future electric hardware and door monitoring positions and include ‘pigtail’ conduit with the system of adequate length to extend 2-feet above the nearest accessible ceiling space.
   a. Note this is required whether or not the door is currently indicated to have electric hardware or security monitoring devices.
4. Coordinate locations of conduit and wiring boxes for electrical connections.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work unless noted otherwise on Drawings.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Provide loose stops and moldings on inside of hollow-metal work.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.10 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016-inch thick.

C. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

PART 3 - EXECUTION

3.1 E-FRAME COORDINATION

A. Coordinate requirements of this section with electric hardware and with security monitoring.
1. For specified hardware and monitoring devices, determine extent of wiring responsibility by each trade and the interface condition between trades.

B. Coordinate exterior and interior HM frames with adjacent accessible ceiling heights to determine extent and location of internal conduit system termination.

3.2 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with SDI A250.11.
1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   a. Coordinate frame installation with electrical and technologies contractors for connection of conduit to electrical junction boxes of all frames with integrated electrical conduit/wiring pathways.
   b. Place frames before construction of enclosing walls and ceilings.
   c. At fire-protection-rated openings, install frames according to NFPA 80.
   d. Install frames with removable stops located on secure side of opening.
   e. Install door silencers in frames before grouting.
   f. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   g. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   h. Field apply bituminous coating to backs of frames, including EMT conduit and wiring boxes, that are filled with grout. Allow coating to set before grouting frame.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
3. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation as indicated on Drawings.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
   a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.

c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
e. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.3 ADJUSTING AND CLEANING

A. Remove grout and other bonding material from hollow metal work immediately after installation.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 11 13

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior and interior storefront framing.
2. Storefront framing for punched openings.
3. Exterior and interior manual-swing entrance doors and door-frame units.

B. Related Sections:
1. Section 07 92 00 "Joint Sealants" for sealants to the extent not specified in this Section.
2. Section 08 71 00 "Door Hardware" for hardware to the extent not specified in this Section.
3. Section 08 80 00 "Glazing" for float and insulating glass requirements.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site with all exterior wall trades in attendance.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings:
1. Shop drawings for storefront entrance systems not prepared directly by the manufacturer shall be submitted to the manufacturer, including the delegated design engineer's calculations, for manufacturer's review and annotation before being submitted to the architect.
2. Shop drawings when submitted to the architect shall bear the complete information of the entity that prepared the drawings and the *manufacturer's* review stamp of acceptability with the reviewer's name and date of review, and shall include any additional details provided by or required by the manufacturer.
   a. Submittals not prepared and reviewed by the manufacturer in accordance with this requirement will be returned without review.
3. Include plans, elevations, sections, full-size details, and anchorage details including delegated design engineer's calculated load reactions into supporting adjacent work of others.
4. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
5. Include details of all frame interfaces with adjacent construction showing each adjacent condition; generic details showing just the frame profile are not acceptable. Specifically show and identify wall construction materials, anchorage material, anchor type and the locations of perimeter sealants and flashings, including air barrier.
6. Include elevations and details of each door type showing compliance with the design; include details of door joinery. Clearly identify all material sizes and wall thicknesses.

C. Samples for Verification: For each type and color of exposed finish required, in manufacturer's standard sizes.

D. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of aluminum-framed systems.
2. Include design calculations.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.

D. Field Water Test Reports: Provide as indicated in Performance Requirements article.

E. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

B. Manufacturer’s Certificate: On storefront system manufacturer’s letterhead, signed by storefront manufacturer certifying that installed storefront system, including anchorage to substrates, complies with shop drawing requirements to the extent verifiable under manufacturer’s site responsibilities.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project. Installer must have ten years continuous successful experience installing product; foreman must have 15 years of experience, include 3 references and contact phone numbers to verify.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Manufacturer’s Expert Observation: Manufacturer is required to provide final certification that work has been performed in accordance with manufacturer’s requirements and reviewed shop drawings as indicated above in Submittals. As determined by the manufacturer in order to provide such certification, contractor shall engage Manufacturer’s Technical Representative or Manufacturer’s Authorized Service Representative to observe work performance and provide expert instruction at the following times:
1. Performance of constructing first mock-up.
2. Water-spray test.
   a. Spray-test observations may be concurrent with the following percentage-of-completion observations if schedules coincide.
3. Storefront systems installation at 100-percent completion.

1.7 MOCKUPS

A. In-Place Mockups: Prior to installing units, completely install one unit of each type while witnessed by Architect, Owners Agent, and Manufacturer’s Authorized Service Representative or Technical Representative, completing all tasks to establish complete work and acceptable means, methods, and finished work.
1. Field testing shall be performed on mockups according to requirements in "Field Quality Control" article.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before installation to verify tolerances are acceptable.

B. Notify Architect of any non-conformance in other's work that interfaces this work, with sufficient advance of planned installation to allow corrections to interfacing work to occur.

1.9 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water penetration through fixed glazing and framing areas.
      e. Failure of operating components.
      f. Fogging or clouding of insulated glass units, except when caused by breakage by impact.
   2. Warranty Period: Five years from date of Contract Completion, except glass unit seals warranty is 10 years from date of manufacture.

B. Special Finish Warranty: Manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 years from date of Contract Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Aluminum Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed entrances and storefronts.

C. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.

D. Structural Loads:
   1. Wind Loads: As indicated on Drawings.

E. Deflection of Framing Members: At design wind pressure, as follows:
   1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.
   a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

F. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

G. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
   a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft..
2. Entrance Doors:
   a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
   b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

H. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

I. Field Water Spray Test: Engage a qualified independent testing agency to perform three separate tests of each system, one element of each type, according to AAMA 501.2; and to provide written report of each test.
1. Test in-place mockups and test installation at 100% complete. Architect shall select specimens in consultation with testing agency.
2. No evidence of water penetration through fixed glazing and framing or joint between framing system and surrounding construction.
3. Perform each series of tests only with the following representatives present:
   a. Owners Agent.
   b. Architect.
   c. System installer.
   d. Manufacturer’s factory authorized service representative.
4. Provide photographic record of each testing process in compliance with Section 01 32 33 “Photographic Documentation”.
5. Testing agency’s written report shall be provided not later than 10-days following each test.

J. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
   b. Low Exterior Ambient-Air Temperature: 0 deg F.
   c. Interior Ambient-Air Temperature: 75 deg F.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kawneer North America; an Arconic company.

2. Manko Window Systems, Inc.
3. Tubelite Storefront and Entrances.
4. EFCO Corporation.
5. Oldcastle Building Envelope, a CRH Company
6. YKK AP America, Inc.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction:
a. For exterior work provide 2” x 4-1/2” typical frame members thermally-improved with minimum 0.080-inch wall thickness for structural mullions, 0.050 inch minimum for trim and stops.
b. For interior work provide 1-3/4” x 4-1/2” typical frame members (non-thermal), unless noted otherwise on Drawings, with same wall thickness as exterior.
c. Provide symmetrically placed expansion frame members as required and accepted in reviewed shop drawings.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.
4. Finish: High-performance organic finish.
5. Fabrication Method: Shop-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
3. Fasteners: 300-Series non-magnetic stainless steel for all joinery potentially in wet zone; corrosion-resistant for all others. All anchors must be bolted; screws not permitted.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard or custom design glazed entrance doors for manual-swing operation. Match elevation designs shown on the drawings except if difference in stile size occurs, the specification shall prevail.
1. Door Construction: 1-3/4-inch minimum overall thickness with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners and intermediate stiles with reinforcing brackets that are deeply penetrated and fillet welded.
2. Door Design: Wide stile; 5-inch nominal width for vertical stiles and top rail, 10-inch nominal width for bottom rail.
3. Glazing: Tempered insulating glass for exterior doors; tempered ¼-inch (nominal) non-insulating glass for interior doors. See Section 08 80 00 “Glazing”.
4. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware." Work of this Section includes receiving hardware from hardware supplier, preparing doors and frames for hardware and installing hardware.

B. Weather Stripping: Manufacturer's standard replaceable components.
1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.6 GLAZING

A. Glazing: As specified in Section 08 80 00 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

D. Glazing Sealants: As recommended by manufacturer.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials, except stainless steel in locations exterior of or at boundary of water barrier.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members at hardware attachment to receive fastener threads; steel plate shall be minimum 1/4-inch thick, aluminum shall be 3/8-inch minimum thick.
3. Do not use exposed fasteners except for hardware application. For hardware applications, use countersunk Phillips screw heads, finished to match framing system or hardware being fastened.

B. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

C. Extruded Aluminum Subframe: At the sill of all exterior storefront frames installed on floor slab, provide continuous, extruded aluminum, thermally-broken, subframe/flashing with end dams whether or not so detailed on the drawings.

D. Extruded Aluminum Head and Jamb Receptors: Where indicated on drawings, provide continuous, extruded aluminum, thermally broken, head and jamb receptor sub-frame to accommodate structural and thermal movements.

E. Aluminum Trim: Provide 2-piece aluminum continuous snap-on trim on all (4) sides of interior perimeter for storefront where indicated on drawings. Trim shall be not less than 0.062-inch- thick extruded aluminum; 3 inches wide by 1-1/2 inches high unless otherwise noted on drawings. Miter or cope corners. Finish shall match finish of storefront framing.

F. Custom Brake-formed Aluminum Sills: Provide under all punched opening frame members to fully divert moisture to the exterior and away from the assembly. Profile shape as indicated and as required for complete control and discharge of moisture.
1. Thickness: 0.094-inch minimum.
2. Finish: Match frames unless otherwise directed.
3. Provide with sealed splice plates under juncture of sill member lengths.
4. Fabricate with end dams and with drip-edge turned down face of wall at least 1-inch except where otherwise detailed.

G. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 07 92 00 "Joint Sealants" unless another type is required to attain the warranty required by this Section.

1. If a different type is required for warranty purposes advise architect as part of shop drawing submittals and include product data and color selector with color range similar to sealant specified.
2. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Factory or shop fabricate and mark major components, disassemble and ship to jobsite for reassembly and field glazing.
1. Field cutting of primary frame extrusions will not be permitted unless field trailer is set up and equipped as a field-shop including heavy (not hand-held) precision cutting and tooling equipment; and quality-control procedures are provided equal to a permanent fabrication shop.

B. Form or extrude aluminum shapes, including brake-form aluminum trim and sills, before finishing.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Perform welding before finishing. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

E. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

F. Storefront Framing: Provide subframes, reinforcing and brake metal fillers of types indicated or, if not indicated, as required for a complete system.

G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide sliding weather stripping at stops to prevent metal to metal contact and to act as silencers.

H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.

I. Entrance Door Hardware Installation:
1. Reinforce for, and factory install entrance door hardware provided in this Section and furnished by other Division 08 Sections, to the greatest extent possible.
   a. Receive hardware from supplier of Door Hardware specified in other Division 08 Sections.
   b. Specifically indicate which hardware is to be factory-installed and which is to be field installed, as part of shop drawings.
2. Cut, drill, reinforce and tap for factory-installed entrance door hardware before applying finishes.
3. Do not field-prep frames or doors for hardware devices; all hardware prep and reinforcing is required to be part of the manufacturing process.

J. After factory or shop fabrication, clearly mark components to identify their locations in Project according to Shop Drawings using same designation numbers as exist on drawings.

2.9 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish, complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: Color and gloss for exterior storefront systems shall match the color and gloss of the finish specified in Section 08 51 13 for “Aluminum Windows”. Architect will select one custom color.

PART 3 - EXECUTION

3.1 ADVANCE COORDINATION

A. Comply with Part 1 Quality Assurance article for participation of Manufacturer’s Technical Representative or Manufacturer’s Authorized Service Representative in mock-up, testing and periodic site visits to observe and report on the Work.

3.2 EXAMINATION

A. Installer of this section’s work shall examine areas and conditions, with Installer of interfacing work present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Inform Architect in writing of corrective work required, if any, or if any conditions do not meet prescribed requirements.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the work at each location is indication of installer’s acceptance of all conditions.

3.3 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions and approved shop drawings. Include custom brake metal sills, fillers and trims indicated.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure nonmovement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation; return sealant line continuous under sill to jambs.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

G. Install glazing as specified in Section 08 80 00 "Glazing."

H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping conforming to specified requirements.
2. Field-Installed Entrance Door Hardware: Most hardware shall be factory installed or be factory-prepared and trial-installed then be removed and packaged separately for shipping for field re-installation. Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible into reinforced backup plates.

I. Fill joint between storefront frame and opening substrate with low-rise, sprayed polyurethane foam sealant to provide an air-tight installation.
1. Trim foam sealant back to accommodate backer rod and joint sealant installation.
2. Install perimeter joint sealants with required backer rod as specified in Section 07 92 00 "Joint Sealants" to produce a weathertight installation.

3.4 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.5 FIELD QUALITY CONTROL

A. Contractor’s Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to perform field water-spray testing as indicated.

B. Contractor shall engage manufacturer’s technical representative and/or authorized independent service representative to perform Quality Assurance observations described in Part 1 “Quality Assurance” article.

C. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

D. Contractor’s Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

E. Owner’s Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections that are in owner’s interest.

F. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

I. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

END OF SECTION 08 41 13

SECTION 08 51 13 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes fixed and operable aluminum-framed windows with integral blinds for exterior locations.

B. Related Requirements:
1. Section 01 40 00 “Quality Requirements” for additional requirements of quality assurance, and definitions including ‘experienced’, ‘manufacturer’s technical representative’, ‘factory authorized service representative’
2. Section 07 92 00 "Joint Sealants" for sealants to the extent not specified in this Section.
3. Section 08 80 00 “Glazing” for glazing requirements of aluminum windows to the extent not specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site with all exterior wall trades in attendance.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchorage, flashing, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

B. Shop Drawings:
1. Shop drawings for windows not prepared directly by the manufacturer shall be submitted to the manufacturer, including the delegated design engineer’s calculations, for manufacturer’s review and annotation before being submitted to the architect.
2. Shop drawings when submitted to the architect shall bear the complete information of the entity that prepared the drawings and the *manufacturer’s* review stamp of acceptability with the reviewer’s name and date of review, and shall include any additional details provided by or required by the manufacturer.
    a. Submittals not prepared and reviewed by the manufacturer in accordance with this requirement will be returned without review.
3. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
4. Plan identifying window locations and type. Use same identifiers as used on construction plans except further identify to distinguish standard insulating-glass windows from *triple-glazed* standard insulating glass windows.
5. Include details of all frame interfaces with adjacent construction showing each adjacent condition.
    a. Generic details showing just the frame profile are not acceptable.

b. Specifically show and identify wall construction materials, anchorage material, anchor type and the locations of perimeter sealants and flashings, including air barrier.

6. Include large-scale details of the following:
   a. Mullion details, including reinforcement and stiffeners.
   b. Joinery details.
   c. Two-piece snap-cover details
   d. Expansion provisions.
   e. Flashing and drainage details.
   f. Weather-stripping details.
   g. Thermal-break details.
   h. Attachment devices and anchors for each condition.
   i. Glazing details.
   j. Internal blind and blind controller details; complete details of interior hinged, glazed aluminum window blind-protection cover. (ADD ALTERNATE)

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

C. Field Water Spray Test Reports: Provide as indicated in “Window Performance Requirements” article below.

D. Sample Warranties: For manufacturer's warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For operating hardware, weather stripping, and finishes to include in maintenance manuals.

B. Manufacturer’s Certificate: Aluminum window manufacturer’s form or letterhead, dated and signed by aluminum window manufacturer certifying that installed aluminum window system of this specific project, including anchorage to substrates, complies with shop drawings and all manufacturer’s requirements to the extent verifiable under manufacturer’s site responsibilities.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

B. Installer Qualifications: An experienced installer acceptable to aluminum window manufacturer for installation of units required for this Project.

C. Product Requirements: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by preconstruction testing before approval of shop drawings and field testing during installation, and in-service performance.

1. Do not revise intended product requirements, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

D. Manufacturer's Expert Observation: Manufacturer is required to provide final certification that work has been performed in accordance with manufacturer's requirements and reviewed shop drawings as indicated above in Submittals. As determined by the manufacturer in order to provide such certification, contractor shall engage Manufacturer's Technical Representative or Manufacturer's Authorized Service Representative to observe work performance and provide expert instruction at the following times:
1. Performance of constructing first mock-up.
2. Each water-spray test.
   a. Spray-test observations may be concurrent with the following percentage-of-completion observations if schedules coincide.
3. Window systems installation at 100-percent completion.

E. In-Place Mockups: Prior to installing units, completely install one unit of each type while witnessed by Architect, Owners Agent, and Manufacturers Authorized Service Representative or Technical Representative, completing all tasks to establish complete work and acceptable means, methods, and finished work.
1. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

B. Notify Architect of any non-conformance in other's work that interfaces this work, with sufficient advance of planned installation to allow corrections to interfacing work to occur.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace aluminum windows that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of materials and finishes beyond normal weathering.
   e. Failure, fogging or clouding of insulated glass units, except when caused by breakage by impact.
2. Warranty Period: Five years from date of Contract Completion, except glass unit seals warranty is 10 years from date of manufacture.

B. Special Finish Warranty: Manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: 20 years from date of Contract Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. EFCO Corporation.
2. Graham Architectural Products Corp.
3. Kawneer; 8400TL (basis-of-design).
4. Manko Windows.
5. Peerless Products Inc..
6. Wausau Window & Wall Systems.

B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Window Certification: AMMA certified with label attached to each window.

B. General Performance: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size equal to project's typical size.
1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
   a. Deflection exceeding specified limits.
   b. Thermal stresses transferring to building structure.
   c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
   d. Noise or vibration created by wind and by thermal and structural movements.
   e. Loosening or weakening of fasteners, attachments, and other components.
   f. Sealant or gasket failure allowing water leaks or excessive air leakage.
   g. Failure of operating units.

C. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
1. Performance Class and Grade: AW 70 minimum.

D. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.450 Btu/sq. ft. x h x deg F. Whole-window U-factor is based on fixed portions of windows with specified insulated glazing in Section 08 80 00 "Glazing" and excluding blind access panel (if any).

E. Field Water Spray Test: Engage a qualified independent testing agency to perform three separate tests of each system, one element of each type, according to AAMA 501.2; and to provide written report of each test.
1. Test in-place mockups, test installation at 30% complete, and installation at 90% complete; Architect shall select specimens in consultation with testing agency.
2. No evidence of water penetration through fixed glazing and framing or joint between framing system and surrounding construction.
3. Perform each series of tests only with the following representatives present:
   a. Owners Agent.
   b. Architect.
   c. System installer.
   d. Manufacturer's factory authorized service representative.
4. Provide photographic record of each testing process in compliance with Section 01 32 33 "Photographic Documentation".
5. Testing agency's written report shall be provided not later than 10-days following each test.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: 120 deg F, ambient; 180 deg F material surfaces.

2.3 ALUMINUM WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Projecting.

B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
1. Thermally Improved Construction: Fabricate primary-window frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
2. Not less than 0.070-inch thickness at any location for the main frame, sash members, and sills.
3. Frame depth: Minimum of 4-inches.
4. Provide reinforced frames and/or heavier profile/thickness frames as necessary for opening and operating units of sizes indicated.
5. Frame appearance must visually match the appearance of adjacent, existing aluminum widows.

C. Glass and Glazing Materials: Refer to Section 08 80 00 "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

D. Anchors, Clips, and Accessories: Aluminum or nonmagnetic stainless steel; provide sufficient strength to withstand design pressure indicated.

E. Hardware, General: Provide manufacturer's standard and heavy-duty hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals.
1. Provide heavy-duty operating hardware as necessary for opening and operating units of sizes indicated. Hardware shall be suited for long life under hard use.
2. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

F. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.
1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/I.S.2/NAFS, and other specified criteria, whichever is most severe.

G. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

H. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement; seal corners with compatible sealant, cut-to-size lengths to compress gaskets into corners.

I. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 07 92 00 "Joint Sealants" unless another type is required to attain the warranty required by this Section.

1. If a different type is required for warranty purposes advise Architect as part of shop drawing submittals and include product data and color selector with color range similar to sealant specified.
2. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

J. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat; apply at surfaces where metals could contact concrete or masonry, or metals could contact different metals.

2.4 ACCESSORIES

A. Aluminum Trim: Provide 2-piece aluminum continuous snap-on trim on all (4) sides of interior window perimeter for windows located in masonry construction. Trim shall be not less than 0.062-inch- thick extruded aluminum; 3 inches wide by 1-1/2 inches high. Miter or cope corners. Finish shall match finish of window units.

B. Panning Trim: Extruded aluminum to profiles to match existing windows.

C. Extruded Aluminum Sills: Provide an extruded aluminum sill at each window in masonry construction, “Alcoa 5468x”, in depth required to accommodate window setback dimension from face of masonry below sill, of 6063-T52 alloy, with “Alcoa SA-100” aluminum anchor clips spaced no more than 30-inches on center. Finish of sills shall match finish of window units.

D. Integral Louver Blinds:
1. Application: As an ADD ALTERNATE provide pricing to provide triple-glazed aluminum windows with integreal blinds for all aluminum windows.
2. Provide remotely operated horizontal louver blinds in the space between insulating glass unit and interior window-blind protection cover.
   a. Construct blinds of aluminum slats approximately 1 inch wide, with polyester fiber cords, equipped for tilting only; fix rigidly to head and sill frames for ‘no raising / lowering’ capability and uniform spacing of slats and alignment of slats in adjacent window units.
   b. Provide standard tilt-operating hardware located on inside face of sash.
      1) Color(s) as selected by architect from industry full lines.
      2) Where bottom of sash is less than 60-inches above finish floor, provide complete knob assembly for tilt-operating control hardware located on the inside face.
      3) Where bottom of sash is greater than 60-inches above finish floor, provide complete female angled tilt-operating blind control hardware located on the inside face for remote operation with manufacturer’s standard poll-operated tilt-control operator.

2.5 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Glazing Stops: Provide snap-on glazing stops coordinated with Section 08 88 00 "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

D. Fabricate aluminum windows that are reglazable without dismantling sash framing, show reglazing methods on shop drawings and in Maintenance Manuals.

E. Weather strip each operable sash to provide weathertight installation.

F. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

G. Open-back window frames are not acceptable. Provide PVC sealant backer/stop at perimeter of windows.

H. Thermally Broken Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.
2. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.

I. Weather Stripping: Provide full-perimeter weather stripping for each operable sash.

J. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water or glazing condensation to exterior. Factory or shop-placed weep holes are required; field drilled weep holes will not be accepted.

K. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish, complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Colors and Gloss: Custom Color to match Architect’s sample.

PART 3 - EXECUTION

3.1 ADVANCE COORDINATION

A. Comply with Part 1 Quality Assurance article for participation of Manufacturer’s Technical Representative or Manufacturer’s Authorized Service Representative in mock-up, testing and periodic site visits to observe and report on the Work.

3.2 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Inform Architect in writing of corrective work required, if any, or if any conditions do not meet prescribed requirements.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

E. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation; return sealant line continuous under sill to jambs.

F. Fill joint between frame and opening substrate with low-rise, sprayed polyurethane foam sealant to provide an air-tight installation.
   1. Trim foam sealant back to accommodate backer rod and joint sealant installation.
   2. Install perimeter joint sealants with required backer rod as specified in Section 07 92 00 "Joint Sealants" to produce a weathertight installation.

3.4 ERECTION TOLERANCES

A. Install aluminum windows to comply with the following maximum tolerances; tolerances include fabrication tolerances, and are not cumulative or additive.
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inchover total length, whichever is less.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.5 FIELD QUALITY CONTROL

A. Contractor shall engage a qualified independent testing and inspecting agency to perform field water-spray testing as indicated and other tests required and not specifically indicated as “owner’s” responsibility.

B. Contractor shall engage manufacturer's technical representative and/or authorized independent service representative to perform Quality Assurance observations described in Part 1 "Quality Assurance" article.

C. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

D. Contractor's Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

E. Owner's Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections that are in owner's interest.

F. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Aluminum window assemblies will be considered defective if they do not pass tests and inspections.

3.6 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
1. Keep protective films and coverings in place until final cleaning.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels immediately and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 08 51 13

SECTION 087111 - DOOR HARDWARE

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Sections:

1. Section 081113 "Hollow Metal Doors and Frames"
2. Section 081416 "Flush Wood Doors"
3. Section 084113 "Aluminum-Framed Entrances and Storefronts"

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: For power, signal, and control wiring and including the following:

a. Details of interface of electrified door hardware and building safety and security systems.
b. Schematic diagram of systems that interface with electrified door hardware.
c. Point-to-point wiring.
d. Risers.
e. Elevations doors controlled by electrified door hardware.

2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and

diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page. Horizontal format schedules are not acceptable and will be returned as not reviewed.
c. Format: Use same scheduling sequence, format, opening numbers, and hardware set numbers as in the Contract Documents.
d. Content: Include the following information:

1) Identification number, location, hand, fire rating, size, and material of each door and frame.
2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
5) Fastenings and other pertinent information.
6) Explanation of abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for door hardware.
8) List of related door devices specified in other Sections for each door and frame.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Architectural Hardware Consultant.

B. Product Certificates: For electrified door hardware, from the manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant or Door + Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:

1. For door hardware, an Architectural Hardware Consultant (AHC) or Door + Hardware Consultant (DHC).

C. Source Limitations: Obtain each type of door hardware from a single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Third party manufacturers that perform electrical modifications are not acceptable.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft.at the tested pressure differential of 0.3-inch wg of water.

F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

G. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf
2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

I. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner, Construction Manager, Contractor, 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. Requirements for access control.
5. Address for delivery of keys.

J. Preinstallation Conference: Conduct conference at Construction Manager’s field office. All relevant trades must attend including, but not limited to, Architect, Construction Manager, Hardware Supplier, General Contractor, Aluminum Storefront Contractor, Hardware Installer, Electrician, and Cabling Contractor.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.
6. Coordinate with other trades requirements for conduit, raceways, and power for installation of Access Control Hardware and Automatic Door Operators.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.8 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: One year from date of Contract Completion, unless otherwise indicated.

a. Exit Devices: Three years from date of Contract Completion (Mechanical Parts).
b. Manual Closers: Ten years from date of Contract Completion.
c. Locksets: Five years from date of Contract Completion.
d. Auto Operators: Two years from date of Contract Completion.

1.10 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Contract Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

PART 2 - **PRODUCTS**

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by descriptive titles corresponding to requirements specified in Part 2.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ives
   b. Hager Companies.
   c. McKinney Products Company; an ASSA ABLOY Group company.

B. Antifriction-Bearing Hinges:

1. Mounting: Full mortise (butts).
2. Bearing Material: Manufacturer's standard antifriction bearing.
3. Grade: Grade 1 (heavy weight), Grade 2 (standard weight).
4. Base and Pin Metal:
   a. Exterior Hinges: Stainless steel with stainless-steel pin.
   b. Interior Hinges: Steel with steel pin] [Stainless steel with stainless-steel pin].
   c. Hinges for Fire-Rated Assemblies: Steel with steel pin.
5. Pins: Nonremovable.
   a. Outswinging Exterior Doors: Nonremovable.
   b. Outswinging Corridor Doors with Locks: Nonremovable.
6. Tips: Flat button.
7. Corners: Square.

2.3 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. IVES Hardware; an Ingersoll-Rand company.
   b. McKinney Products Company; an ASSA ABLOY Group company.
   c. Select Products Limited.
   d. National Guard Products.
2. Grade: Grade 1-600.

3. Hinges for Fire-Rated Assemblies: With steel fire pins to hold fire-rated doors in place if required by tested listing.
4. Mounting: Concealed leaf.
5. Electric Option: Electric power transfer.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
1. Mortise Locks: Minimum 3/4-inchlatchbolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: Curved lever as indicated in sets.
2. Levers: Cast.
a. 17 Lever as indicated in sets.
3. Roses: Wrought.
4. Operating Device: Lever with escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

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

a. Schlage L Series.
b. Best 40H Series.
c. Corbin-Russwin ML2000 Series.

2. Backset: 2-3/4 inches
3. Material: Stainless steel.

2.5 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade [1] [2]; with faceplate to suit lock and frame.

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

a. Rutherford Controls

b. Von Duprin 6000 series.
c. Folger-Adam 700 Series.

2. Material: Stainless steel.
3. Mounting: Mortised or Rim mounted.
4. Fire-Rated Door Assemblies: Use fail-secure electric strikes with fire-rated devices.

2.6 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 1; motor or solenoid driven; bored or mortise latchbolt; with strike that suits frame.

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

a. Schlage.
b. Best
c. Corbin-Russwin

2.7 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inchthrow; designed for mortising into door edge.

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

a. IVES Hardware; an Ingersoll-Rand company.
b. Door Controls International, Inc.
c. Trimco.

B. Manual-Extension Flush Bolts: Grade 1, fabricated from extruded brass or aluminum, with 12-inchrod actuated by flat lever; listed and labeled for fire-rated doors. Provide with matching dustproof strike.

C. Dustproof Strikes: Grade 1, polished wrought brass, with 3/4-inch-diameter, spring-tension plunger.

2.8 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

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

a. IVES Hardware; an Ingersoll-Rand company.
b. Door Controls International, Inc.
c. Trimco.

B. Automatic Flush Bolts: Grade 1, fabricated from steel and brass components, with spring-activated bolts that automatically retract when active leaf is opened and that automatically engage when active door depresses bolt trigger; listed and labeled for fire-rated doors. Provide brass or stainless-steel cover plate, top and bottom matching dustproof strikes, guides, guide supports, wear plates, and shims.

C. Dustproof Strikes: Grade 1, polished wrought brass, with 3/4-inch- diameter, spring-tension plunger.

2.9 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

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

   a. Von Duprin; 99 Series.
   b. Detex; Advantex Series.
   c. Corbin-Russwin ED5000 Series.

B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

D. Rim Exit Devices: Grade 1.

1. Type: Type 1, rim.
2. Grade: Grade 1.
3. Actuating Bar: Push pad.
4. Material: Stainless steel.
5. Electrified Options:

   a. Pushpad monitor switch.
   b. Electric locking and unlocking.
   c. Latchbolt monitor.
   d. Motorized latch retraction.

E. Mortise Exit Devices: Grade 1.

1. Type: Type 3.
2. Grade: Grade 1.
3. Actuating Bar: Push pad.
4. Material: Stainless steel.

F. Concealed Vertical-Rod Exit Devices: Grade 1.

1. Type: Type 8, for metal doors.
2. Grade: Grade 1.
3. Actuating Bar: Push pad.
4. Material: Stainless steel.
5. Concealed vertical rod devices – Less Bottom Rod

G. Tube-Steel Removable Mullions: With malleable-iron top and bottom retainers, and prepared for strikes as follows:

1. Strikes: Two standard surface strikes.

H. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire and panic protection, based on testing according to UL 305 and NFPA 252. Use mullions only with exit devices for which they have been tested.

I. Exit Device Outside Trim: Lever; material and finish to match locksets, unless otherwise indicated.

J. Through-Bolt Fasteners: For exit devices and trim on hollow metal doors, non-fire-rated wood doors, and fire-rated wood doors.

2.10 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

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

a. Schlage Everest 29 FSIC
b. Corbin Russwin Access 3 AS FSIC
c. Best Peaks 140 Series

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are removable; face finished to match lockset.

1. Number of Pins: Six.

C. High-Security Lock Cylinders: BHMA A156.30; Grade 1; Type M, mechanical; permanent cores that are removable; face finished to match lockset.

1. Number of Pins: Six.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores where indicated. Provide disposable plastic cores for all other cores. Provide 10 construction master keys.

2.11 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE".

2. Quantity: One extra key blank for each lock, provide the following:

2.12 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.

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

a. IVES Hardware; An Ingersoll-Rand Company.
b. Hager Companies.
c. Hiawatha, Inc.
d. Rockwood Manufacturing Company.
e. Trimco.

B. Flat Push Plates: 0.050 inch thick, 6 inches wide by 16 inches high with square corners and beveled edges; secured with exposed screws.

C. Push-Pull Plates: 1/8 inch thick, 6 inches wide by 16 inches high with square corners, beveled edges, and raised integral lip; secured with exposed screws.

D. Straight Door Pulls: With minimum clearance of 1-1/2 inches from face of door.

1. Type: 3/4-inchconstant-diameter pull.
2. Mounting: Through bolted with oval-head machine screws and countersunk washers.
3. Overall Length: 9 inches

E. Offset Door Pulls: 1-inchconstant-diameter pull with minimum clearance of 2-1/4 inches from face of door and offset of 2 inches.

1. Mounting: Through bolted with oval-head machine screws and countersunk washers.
2. Overall Length: 18 inches

F. Flush Door Pulls: Mortised 1/2 inch deep; secured with screws.

1. Shape: Rectangular with rectangular recess.
2. Size: 3-1/2 inches wide by 4-3/4 inches high.

2.13 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

2.14 SURFACE CLOSERS AND LOW ENERGY OPERATORS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

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

   Surface:
   a. LCN Closers 4041XP.
   b. Corbin-Russwin DC8000 Series.
   c. Stanley CLD4551.

   Low Energy Operators:
   d. LCN 9500 Sr. Swing.
   e. Besam SW100 Series.
   f. Detex A019 Series.

B. Cast-Iron Surface Closers: Grade 1; Traditional Type with mechanism enclosed in cast-iron shell.

1. Mounting: Interior of room, away from corridor.
2. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.
3. Cover Material: Metal.
4. Closing Power Adjustment: Adjustable from size 1-6.
5. No pressure relief valves allowed. (PRV)

C. Low Energy Power Operators: Grade 1; Traditional Type with mechanism enclosed in cast-iron shell.

1. Operation: Pushbutton, pushplate, switch-activated, manual or field-programmable manual/electric power assisted Push ‘N’ Go opening with Power Boost closing and holding; comply with ANSI A156.19, UL 325 and UL 1998

2.15 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; cast brass, bronze, or aluminum, or stainless steel base metal.

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

   a. IVES Hardware; an Ingersoll-Rand company.
   b. Baldwin Hardware Corporation.
   c. Burns Manufacturing Incorporated.
   d. Hager Companies.
   e. Hiawatha, Inc.
   f. Rockwood Manufacturing Company.
   g. Trimco.

B. Rigid-Type Floor Stop: Grade 1; with rubber bumper; for expansion-shield application.

C. Dome-Type Floor Stop: Grade 1; with minimum 1-inch-high bumper for doors without threshold and 1-3/8-inch-high bumper for doors with threshold.

D. Wall Bumpers: Grade 1; with rubber bumper; 2-1/2-inchdiameter, minimum 3/4-inchprojection from wall; solid cast brass, bronze, or stainless steel; with concave bumper configuration.

E. Plunger-Type Door Holders: Grade 1; minimum 1-1/8-inchplunger throw; with replaceable rubber tip; for surface-screw application.

2.16 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies.

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

a. LCN SEM
b. Rixson 998 Series
c. ABH 2100

2.17 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

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

a. Glynn-Johnson.
b. ABH.
c. Rixson.

B. Overhead Concealed Slide Holders: Type 1; Grade 1; hold open and release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for single-acting doors opening 110 degrees.

C. Overhead Concealed Slide Stops: Type 1; Grade 1; release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for single-acting doors opening 110 degrees.

D. Overhead Surface-Mounted Slide Holders: Type 2; Grade 1; hold open and release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for single-acting doors opening 110 degrees.

E. Overhead Surface-Mounted, Concealed Slide Stops: Type 2; Grade 1; release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for single-acting doors opening 110 degrees.

2.18 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per footof crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

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

a. National Guard Products.
b. Zero International.
c. Hager Companies.
d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
e. Reese Enterprises, Inc.

B. Rigid, Housed, Perimeter Gasketing: Sponge neoprene gasket material held in place by bar stock aluminum housing; fastened to frame stop with screws.

C. Door Sweeps: Neoprene gasket material held in place by flat aluminum housing or flange; surface mounted to face of door with screws.

D. Automatic Door Bottoms: Sponge neoprene gasket material held in place by aluminum housing that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.

1. Mounting: Surface mounted on face of door.
2. Type: Low-closing-force type for doors required to meet accessibility requirements.

2.19 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

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

a. National Guard Products.
b. Zero International.
c. Hager Companies.
d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
e. Reese Enterprises, Inc.

B. Saddle Thresholds:

1. Type: Fluted top, barrier free.
2. Base Metal: Aluminum.

C. Latching/Rabbeted Thresholds with Gasket: Fluted-top metal member with gasket.

1. Type: Offset.
2. Base Metal: Aluminum.
3. Gasket Material: Neoprene.

D. Plate Thresholds: Solid metal plate.

1. Top Surface: Fluted.
2. Base Metal: Aluminum.

2.20 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

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

a. IVES Hardware; an Ingersoll-Rand company.
b. Burns Manufacturing Incorporated.
c. Hiawatha, Inc.
d. Rockwood Manufacturing Company.
e. Trimco.

B. Armor Plates: 36 inches high by door width with allowance for frame stops.

C. Kick Plates: 10 inches high by door width with allowance for frame stops.

D. Mop Plates: 4 inches high by 1 inch less than door width.

2.21 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

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

a. IVES Hardware; an Ingersoll-Rand company.
b. Hager Companies.
c. Rockwood Manufacturing Company.
d. Trimco.

B. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

2.22 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

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

a. Schlage and Von Duprin.
b. ABH (PT-1000 only).
c. Securitron
d. Security Door Controls.

B. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; listed and labeled for

use with fire alarm systems. Power supplies to be of same manufacturer as door locks or exit devices.

C. Door Position Switches: Magnetically operated DPDT reed switch designed for concealed mounting. Switch must be 4-7/8" x 1" mortise plate mount style.

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

a. Interlogix 2757DL
b. George Risk Industries.

D. Door and Frame Transfer Devices: Steel housing for mortise in hinge stile of door, with telescoping tube for wiring bundle; accommodating doors that swing open to 120 degrees. Spring style transfer tube not allowed.

2.23 Windstorm Rated (FEMA 361) Door Hardware:

A. Provide fire exit hardware to meet Hollow Metal manufacturers design criteria for the rating and function required.

B. Openings to have lock cylinders capable of keying into new system.

C. Closers shall have a spring type cushioned arm stop.

D. Openings shall have gasketing and/or threshold required for fire and/or environmental conditions.

E. Doors shall be operable with no greater than 15 lbs. of opening force.

F. Hardware is not required to match manufacturers of all other hardware of similar types.

2.24 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for

installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:

   a. Wood or Machine Screws: For the following:

      1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors.
      2) Strike plates to frames.
      3) Closers to doors and frames.

   b. Steel Through Bolts: For the following:

      1) Surface hinges to doors.
      2) Closers to doors and frames.
      3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.25 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - **EXECUTION**

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Furnish permanent cores to Owner for installation.

E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

H. Stops: Provide wall stops for doors unless floor or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

I. Perimeter Gasketing: Apply to head and jamb prior to mounting closer shoe or panic strikes, forming seal between door and frame. Coordinate templates accordingly.

J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Architectural Hardware Consultant: Hardware supplier will engage a qualified Architectural Hardware Consultant or Door + Hardware Consultant to perform inspections and to prepare inspection reports.

1. Architectural Hardware Consultant or Door + Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Hardware Installer shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

SET 01

Doors:
195, 197, 198A, 207A, 207C

2	Continuous Hinge	112HD EPT x DH	628	IVE
2	Power Transfer	EPT10 CON	689	VD
2	OH Stop	100S	630	GJ
1	Card Reader by Div. 26	CARD READER	-	BO
1	Wiring Diagram By HDW	WD	-	SUP
2	ANSI Door Contact DPDT	2757DL	ALUM	INT
1	Exit Device	RX-LD-99EO x CON	626	VD
1	Exit Device	QEL-RX-99NL x 990NL x CON	626	VD
1	Mortise Cylinder	20-059	626	SCH
1	Rim Cylinder	20-079	626	SCH
2	Core (Restricted)	23-030 EV29 T	626	SCH
2	Core (Temp)	23-030 ICX	BLK	SCH
1	KR Mullion	4954 x KR54 x 154	689	VON
2	Closer	4040XP EDA-30-61 MC	689	LCN
1	Latchtrack Threshold	896HDN x DW MS/LA	AL	NGP
2	Sweep	200NA x DW	ANOD	NGP
1	Weatherstripping by Aluminum	W/S	-	BO
1	Mullion Seal	5100	BLK	NGP
1	Junction Box w/ DPDT Relay	JB7-R2	-	VD
1	Power Supply - See MISC	PS	-	HDW

SET 02

Doors:
188, 207B

1	Continuous Hinge	112HD EPT x DH	628	IVE
1	Power Transfer	EPT10 CON	689	VD
1	OH Stop	100S	630	GJ
1	Card Reader by Div. 26	CARD READER	-	BO
1	Wiring Diagram By HDW	WD	-	SUP
1	ANSI Door Contact DPDT	2757DL	ALUM	INT
1	Exit Device	QEL-RX-99NL x 990NL x CON	626	VON
1	Rim Cylinder	20-079	626	SCH
1	Core (Restricted)	23-030 EV29 T	626	SCH
1	Core (Temp)	23-030 ICX	BLK	SCH
1	Closer	4040XP EDA-30-61 MC	689	LCN
1	Latchtrack Threshold	896HDNxDW MS/LA	AL	NGP
1	Sweep	200NA x DW	ANOD	NGP
1	Junction Box w/ DPDT Relay	JB7-R2	-	VD
1	Power Supply - See MISC	PS	-	HDW

SET 02

Doors:
1001A

1	Continuous Hinge	112HD EPT x DH	628	IVE
1	Power Transfer	EPT10 CON	689	VD
1	OH Stop	100S	630	GJ
1	Card Reader by Div. 26	CARD READER	-	BO
1	ANSI Door Contact DPDT	2757DL	ALUM	INT
1	Wiring Diagram By HDW	WD	-	SUP
1	Electric Mortise Lock	L9092JEU-RX x 17A	626	SCH
1	Core (Restricted)	23-030 EV29 T	626	SCH
1	Core (Temp)	23-030 ICX	BLK	SCH
1	Closer	4040XP EDA MC	689	LCN
1	Power Supply - See MISC	PS	-	HDW

SET 03

Doors:

199C, 201A, 201D, 203B, 205

2	Continuous Hinge	112HD EPT x DH	628	IVE
2	OH Stop	100S	630	GJ
2	Exit Device	99DT x 990DT x CON	626	VD
1	Mortise Cylinder	20-059	626	SCH
2	Core (Restricted)	23-030 EV29 T	626	SCH
2	Core (Temp)	23-030 ICX	BLK	SCH
1	KR Mullion	4954 x KR54 x 154	689	VON
2	Closer	4040XP EDA-30-61 MC	689	LCN
2	Sweep	200NA x DW	ANOD	NGP
1	Latchtrack Threshold	896HDN x DW MS/LA	AL	NGP
1	Mullion Seal	5100	BLK	NGP
1	Weatherstripping by Aluminum	W/S	-	BO

SET 04

Doors:

156, 199A, 199B, 199D, 201B, 201E, 203A, 203C

1	Continuous Hinge	112HD EPT x DH	628	IVE
1	OH Stop	100S	630	GJ
1	Exit Device	99DT x 990DT x CON	626	VD
1	Mortise Cylinder	20-059	626	SCH
1	Core (Restricted)	23-030 EV29 T	626	SCH
1	Core (Temp)	23-030 ICX	BLK	SCH
1	Closer	4040XP EDA-30-61 MC	689	LCN
1	Sweep	200NA x DW	ANOD	NGP
1	Latchtrack Threshold	896HDN x DW MS/LA	AL	NGP
1	Mullion Seal	5100	BLK	NGP
1	Weatherstripping by Aluminum	W/S	-	BO

SET 05

Doors:

188C, 201C

2	Continuous Hinge	112HD EPT x DH	628	IVE
2	OH Stop	100S	630	GJ
2	Exit Device	99DT x 990DT x CON	626	VD
1	Core (Temp)	23-030 ICX	BLK	SCH
1	Mortise Cylinder	20-059	626	SCH
1	Core (Restricted)	23-030 EV29 T	626	SCH
1	KR Mullion	4954 x KR54 x 154	689	VON
2	Closer	4040XP EDA MC	689	LCN
1	Mullion Seal	5100	BLK	NGP
1	Weatherstripping	700NA x DW x DH	ANOD	NGP
2	Sweep	200NA x DW	ANOD	NGP

SET 06

Doors:

188D, 191

1	Continuous Hinge	112HD EPT x DH	628	IVE
1	Exit Device	99DT x 990DT x CON	626	VD
1	Closer	4040XP SCUSH MC	689	LCN
1	Gasketing	700NA x DW x DH	ANO	NGP
1	Sweep	200NA x DW	ANOD	NGP
1	Latchtrack Threshold	896HDN x DW MS/LA	AL	NGP

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows (factory glazed).
   2. Doors.
   3. Glazed entrances.
   4. Storefront framing.

B. Related Requirements:
   1. Section 08 11 13 "Hollow Metal Doors and Frames" and Section 08 14 16 "Flush Wood Doors" for view panels and glass stops in these doors and in HM Frames.
   2. Section 08 41 13 "Aluminum Framed Entrance and Storefronts" for aluminum door and framing to receive glass.
   3. Section 08 51 13 "Aluminum Windows" for fixed and operable aluminum windows to be factory glazed in compliance with requirements of this Section.

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

1.3 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of the following products; 12 inches square.
   1. Spandrel glass.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturers of insulating-glass units with sputter-coated, low-E coatings.

B. Product Certificates: For glass.

C. Product Test Reports: For coated glass and insulating glass, for tests performed by a qualified testing agency.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Cleaning instructions and perimeter seal and gasket inspection instructions.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: 10 years from date of Contract Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   1. Warranty Period: 10 years from date of Contract Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Primary Glass Manufacturers: Subject to compliance with requirements, provide primary glass products by one of the following:
   1. AGC Flat Glass North America.
   2. Cardinal Glass Industries.
   3. Guardian Industries Corp.

4. Pilkington Building Products North America.
5. Vitro Architectural Glass.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

C. Source Limitations for Coated Glass: Obtain from single source from single manufacturer for each glass type.

D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand specified thermal movement, wind loads, and normal impacts without failure, including loss or glass breakage attributable to the following: shading from architectural arrangement on building or in frame, defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Glass thickness and strength designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness and strength designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed performance requirements.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
   a. Basic Wind Speed: 90 mph.
   b. Importance Factor: 1.15.
   c. Exposure Category: C.
2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

E. Strength: Provide fully tempered float glass for all glass lites whether or not indicated on the Drawings.

2.4 GLASS PRODUCTS

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

B. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.

C. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. Manufacturer shall evaluate all individual glazing conditions of the project for conditions that result in overstressing any glass, including any that cause thermal stress, and shall provide heat-strengthened or tempered glass at all additional locations it deems necessary in order to prevent stress cracking or breakage.
a. Replacement of glass necessitated by stress cracking or breakage shall be fully the contractor’s obligation without additional cost to the Owner.
2. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
3. Spacer: Nonmetallic tube.
4. Desiccant: Molecular sieve or silica gel, or blend of both.

2.7 GLAZING SEALANTS

A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

2.11 MONOLITHIC GLASS SCHEDULE

A. Glass Type **(G-1)**: Clear fully tempered float glass.
1. Thickness: 6.0 mm.

2.12 LAMINATED GLASS SCHEDULE

A. Glass Type **(G-2)**: Clear laminated glass with two plies of fully tempered float glass.
1. Minimum Thickness of Inner Glass Ply: 10 mm.
2. Interlayer Thickness: 0.060 inch.
3. Minimum Thickness of Outer Glass Ply: 6 mm.

2.13 INSULATING GLASS SCHEDULE

A. Glass Type **(IG-1):** Low-E-coated, clear insulating glass.
1. Low-E Coating Manufacturers: Subject to compliance with requirements, provide one of the following products:
a. AGC Flat Glass North America; Energy Select 28.
b. Cardinal Glass Industries; LoE-366.
c. Guardian; SunGuard SNX62/27.
d. Viracon; VNE 1-63 Low E.
e. Vitro Architectural Glass; Solarban 70 XL.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.

4. Outdoor Lite: Clear, fully tempered float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Clear, fully tempered float glass.
7. Low-E Coating: Sputtered on second or third surface.
8. Winter Nighttime U-Factor: .28 maximum.
9. Summer Daytime U-Factor: .27 maximum.
10. Visible Light Transmittance: 62 percent minimum.
11. Solar Heat Gain Coefficient .28 maximum.

B. Glass Type **(IG-2):** Ceramic-coated, Low-E-coated, insulating vision glass.
1. Low-E Coating Manufacturers: Subject to compliance with requirements, provide one of the following products:
   a. AGC Flat Glass North America; Energy Select 40 (2).
   b. PPG Industries; Solarban 70 XL.
   c. Viracon; VNE 1-63 Low E.
   d. Guardian; SunGuard SNX62/27.
   e. Cardinal Glass Industries; LoE-366.
2. Ceramic Coating Color and Pattern: Full coverage translucent frit
   a. Basis-of-Design Product: Subject to compliance with requirements, provide Viracon Viraspan Simulated Sandblast V1086 or a comparable product by one of the following:
      1) AGC Flat Glass North America
      2) Guardian
      3) PPG Industries
      4) Cardinal Glass Industries
3. Overall Unit Thickness: 1 inch.
4. Minimum Thickness of Each Glass Lite: 6 mm.
5. Outdoor Lite: Clear, fully tempered float glass.
6. Interspace Content: Argon.
7. Indoor Lite: Clear, fully tempered float glass.
8. Low-E Coating: Sputtered on second or third surface.
9. Ceramic Coating Location: Second surface.
10. Winter Nighttime U-Factor: .28 maximum.
11. Summer Daytime U-Factor: .27 maximum.
12. Visible Light Transmittance: 55 percent minimum.
13. Solar Heat Gain Coefficient .28 maximum.

C. Glass Type **(ISG-1)**: Ceramic-coated, insulating spandrel glass.
1. Coating Color: As selected by Architect from manufacturer's full range.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Clear, fully tempered float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Clear, fully tempered float glass.
7. Coating Location: Fourth surface.

2.14 TRIPLE GLAZED WINDOW UNITS

A. Application:
1. For integral blind ADD ALTERNATE.

B. Triple glazing requirements are as follows.
1. Insulating-glass unit as indicated, at the outside standard glazing position of frames.
2. Between the glass blinds as specified in Section 08 51 13.
3. 6 mm thick clear tempered glass interior lite in aluminum frame hinged window panel.

C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

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

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead without impeding internal drainage.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter, masonry mortar, and masonry cleaner. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass as soon as practical that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Contract Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

SECTION 08 91 19 – FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
1. Fixed, extruded-aluminum exterior wall louvers.

B. Related Requirements:
1. Division 23 “HVAC” for work by other trades that interfaces with louvers.

1.2 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

C. Wind-Driven-Rain-Resistant Louver: Storm-resistant louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.
3. Show large-scale attachment head, jamb, and sill details that include actual conditions of adjacent materials to which louvers will attach.

C. Samples for Initial Selection: For units with factory-applied color finishes.
1. Provide actual material samples of the full range of colors available; color charts, printed and photographic representations, or web-site references for color will not be accepted.
a. Do not submit manufacturer who is unable or unwilling to provide real material samples.

D. Samples for Verification: For each type and of metal finish selected in initial samples.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Wind-Driven-Rain-Resistant Louver: Provide for all louvers greater than 12 inches in height.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Airolite Company, LLC (The); SCH501.
   b. All-Lite Architectural Products; ECD-545.
   c. Construction Specialties, Inc.; RSH-5700.
   d. Greenheck Fan Corporation; EHH-501.
   e. Industrial Louvers Inc; SP-537.
   f. Ruskin Company; Tomkins PLC; EME520DD.
2. Louver Depth: 5 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch thick for frames and 0.060 inch thick for blades.
4. Sill: Custom brake-formed loose sills, made of aluminum, .094-inch thick, formed with end dams and as indicated on the Drawings for drainage to exterior and to prevent water penetrating to interior. Provide sills with same finish as louvers
5. Sizes: As indicated on the drawings.
6. Louver Performance Ratings:
   a. Free Area: Not less than 6.8 sq. ft. for 48-inch- wide by 48-inch- high louver.
   b. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area intake velocity.
   c. Wind-Driven Rain Performance: Not less than 99.5 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 600 fpm.
7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal, Wind-Driven-Rain-Resistant Louver: Provide for all louvers 12 inches or less in height
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Airolite Company, LLC (The).
   b. All-Lite Architectural Products.
   c. Construction Specialties, Inc.
   d. Greenheck Fan Corporation.
   e. Industrial Louvers Inc.
   f. Ruskin Company; Tomkins PLC; EME220DD (Basis-of-Design).

2. Louver Depth: 2 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.060 inch thick for frames and 0.045 inch thick for blades.
4. Sill: Custom brake-formed loose sills, made of aluminum, .094-inch thick, formed with end dams and as indicated on the Drawings for drainage to exterior and to prevent water penetrating to interior. Provide sills with same finish as louvers
5. Sizes: As indicated on the drawings.
6. Louver Performance Ratings:
   a. Free Area: Not less than 6.8 sq. ft. for 48-inch- wide by 48-inch- high louver.
   b. Air Performance: Not more than 0.10-inch wg static pressure drop at 500-fpm free-area intake velocity.
   c. Wind-Driven Rain Performance: Not less than 99.0 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 400 fpm.
7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.
   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
   1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
   2. Finish: Mill finish.
   3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening:
   1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

2.5 BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.
   1. Thickness: 2 inches.
   2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
   3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
   4. Provide aluminum channel stiffeners in core as necessary to prevent panel from bowing or deflecting under wind and equipment-driven air movement loads.
   5. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
   6. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
   7. Panel Finish: Same finish applied to louvers, but black color.
   8. Attach blank-off panels with sheet metal screws.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.
   1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
   2. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated on the drawings as part of the louver design appearance.

C. Maintain equal louver blade spacing to produce uniform appearance.

D. Fabricate frames, including custom sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: Channel.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.
1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.

G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and gloss for louvers shall match the color and gloss of the finish specified in Section 07 42 13 for “Metal Wall Panels”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect aluminum surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Fill joint between louver frame and opening substrate with low-rise, sprayed polyurethane foam sealant to provide an air-tight installation. Trim foam sealant back to accommodate backer rod and joint sealant installation. Install perimeter joint sealants with required backer rod as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
   1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 90 00

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

1.2 SUBMITTALS

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

B. Shop Drawings: 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.

1.3 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: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Manufacturers
1. Anvil
2. B-Line Systems, Inc.; a division of Cooper Industries
3. ERICO/Michigan Hanger Co.
4. Grinnell Corp.

5. PHD Manufacturing

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. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
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.

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.

2.4 FASTENER SYSTEMS

A. Manufacturers
1. B-Line Systems, Inc.; a division of Cooper Industries
2. Hilti, Inc.
3. ITW Ramset/Red Head.

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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Non-staining, non-corrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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 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.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

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.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation 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 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. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
3. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

4. 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.
5. 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.
6. 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.
7. 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 mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 221017 – 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. Gas pressure regulators.

1.3 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.

B. Natural-Gas System Pressure within Buildings: 7 inches water column.

1.4 SUBMITTALS

A. Product Data: For each type of the following:
1. Pipe and fittings inside the building.
2. Shutoff valves.
3. Underground pipe to the emergency generator.

B. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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 and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

C. Protect stored PE pipes and valves from direct sunlight.

1.7 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 Division 08 Section "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.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Mechanical Couplings:

    a. Stainless-steel flanges and tube with epoxy finish.
    b. Buna-nitrile seals.
    c. Stainless-steel bolts, washers, and nuts.
    d. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    e. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

2.2 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 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.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. 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.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" 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.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. 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.
    c. McDonald, A. Y. Mfg. Co.
    d. Milliken Valve Company.
    e. Mueller Co.; Gas Products Div.
    f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.

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.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product 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. Sensus.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.

10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
12. Maximum Inlet Pressure: 5 psi.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

A. Comply with International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 24 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

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. 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.

G. 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.

H. 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.

3.2 INDOOR PIPING INSTALLATION

A. Comply with 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. Install escutcheons at penetrations of interior walls, ceilings, and floors.

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."

M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

O. 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.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Q. 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.

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.

R. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

S. Connect branch piping from top or side of horizontal piping.

T. 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.

U. Do not use natural-gas piping as grounding electrode.

V. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

3.3 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. 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. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

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.

3. 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 steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. 1/2" and Smaller: 6 feet with 3/8-inch rod.
2. 3/4” to 1”: 8 feet with 3/8-inch rod.
3. NPS 1-1/4” and larger: 10 feet with 1/2-inch rod.

E. Install supports for vertical steel pipe at every floor level.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.6 LABELING AND IDENTIFYING

A. Comply with requirements in Division 22 Section "Identification for Plumbing 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.

3.7 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting exterior natural-gas piping.

B. Paint exposed, exterior metal piping and valves.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.

b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (gloss).
d. Color: Gray.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections. Contact the local utility, the owner and the authority having jurisdiction 48 hours prior to test so it can be witnessed.

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.

3.9 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping 2” and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping 2-1/2” and larger shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

3.10 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger shall be the following:

1. Cast-iron, lubricated plug valve.

C. Valves in branch piping for single appliance shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

END OF SECTION 231123

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.2 SUBMITTALS

A. Welding certificates.

1.3 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.

PART 2 - PRODUCTS

2.1 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.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is 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, BCuP Series or BAg1, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12.

2.3 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.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. 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.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

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.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. 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.

P. Verify final equipment locations for roughing-in.

Q. 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.

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. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install 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 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.6 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.

3.7 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.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Provide shaft grounding ring.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Alignment guides and anchors.
2. Pipe loops and swing connections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

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

    a. Adsco Manufacturing LLC
    b. Flex-Hose Co., Inc
    c. Flex-Weld, Inc
    d. Hyspan Precision Products, Inc.
    e. Mason Industries, Inc.
    f. The Metraflex Company

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
    b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
    c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install minimum of one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.

1.3 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

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. Ashcroft Inc.
2. Ernst Flow Industries.

3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.
13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. Flo Fab Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Tel-Tru Manufacturing Company.

k. Trerice, H. O. Co.

l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

m. Weiss Instruments, Inc.

n. WIKA Instrument Corporation - USA.

o. Winters Instruments - U.S.

2. Standard: ASME B40.100.

3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.

6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.

8. Pointer: Dark-colored metal.

9. Window: Glass.

10. Ring: Stainless steel.

11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

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. Flow Design, Inc.

2. Miljoco Corporation.

3. National Meter, Inc.

4. Peterson Equipment Co., Inc.

5. Sisco Manufacturing Company, Inc.

6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending into fluid a distance equal to its sensitive length plus a minimum of one inch and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install test plugs in piping tees.

L. Install flow indicators in piping systems in accessible positions for easy viewing.

M. Install permanent indicators on walls or brackets in accessible and readable positions.

N. Install connection fittings in accessible locations for attachment to portable indicators.

O. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic coil in air-handling units.
3. Outside-, return-, supply-, and mixed-air ducts.
4. Where indicated on drawings.

P. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each condenser-water connection.
3. Suction and discharge of each pump.
4. Where indicated on drawings.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.

B. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.

C. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.

D. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Hot Water Piping: 30 to 240 deg F.

B. Scale Range for Air Ducts: Minus 40 to plus 160 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at inlet and outlet of each ground-source-water connection shall be the following:

1. Liquid-filled, direct-mounted, metal case.

B. Pressure gages at suction and discharge of each pump shall be one of the following:

1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Hot Water Piping: 0 to 160 psi.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.
4. Bronze gate valves.
5. Bronze globe valves.
6. Chainwheels.
7. Bronze, Calibrated-Orifice, Balancing Valves.
8. Cast-Iron, Ductile Iron, or Steel Calibrated Orifice Balancing Valves.
9. Automatic Flow Control Valves

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

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.

1.4 ACTION 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.

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 HVAC 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. 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.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Red-White Valve.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze, complying with ASTM B 61, ASTM B 62, or ASTM B 584 Alloy C8440)
   f. Ends: Threaded.
   g. Seats: PTFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

2.3 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. ITT Bell and Gossett.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Red-White Valve.
   i. 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 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

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. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
   b. American Valve, Inc.
   c. Conbraco Industries, Inc.; Apollo Valves.
   d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. DeZurik Water Controls.
   h. Flo Fab Inc.
   i. Hammond Valve.
   j. ITT Bell and Gossett.
   k. Milwaukee Valve Company.
   l. NIBCO INC.
   m. Red-White Valve.
   n. Norriseal; a Dover Corporation company.
   o. Spence Strainers International; a division of CIRCOR International.
   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 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Stainless steel.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American 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. Red-White Valve.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.5 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. 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. Red-White Valve.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:
a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.6 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.

d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. Zy-Tech Global Industries, Inc.

2. Description:
a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

2.7 CHAINWHEELS

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. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly valve stems.
3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

2.8 Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

2.9 BRONZE, CALIBRATED-ORIFICE, BALANCING VALVES:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Flow Design Inc.
d. Gerand Engineering Co.
e. Griswold Controls.
f. Red-White Valve Corp.
g. Taco.
h. Tour & Andersson; available through Victaulic Company of America
2. Body:
a. Bronze, ball or plug type with calibrated orifice or venturi.
b. Ametal brass copper alloy, y-pattern, globe type.
3. Ball: Brass or stainless steel.
4. Plug: Resin.

5. Seat: PTFE or Ametal.
6. End Connections: Threaded, soldered, or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style:
   a. Lever, with memory stop to retain set position.
   b. Multiple-turn digital readout handwheel and concealed memory feature with locking, tamper-proof setting.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

2.10 CAST-IRON, DUCTILE IRON, OR STEEL CALIBRATED ORIFICE BALANCING VALVES:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Red-White Valve Corp.
   g. Taco.
   h. Tour & Anderson
2. Body: Cast-iron, ductile iron, or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE or ductile iron.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style:
   a. Lever, with memory stop to retain set position.
   b. Multiple-turn digital readout handwheel and concealed memory feature with locking, tamper-proof setting.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

2.11 AUTOMATIC FLOW CONTROL VALVES:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Flow Design Inc.
   b. Griswold Controls.
   c. Bell and Gossett.
   d. Red-White Valve Corporation.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.

7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.

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 AND APPLICATIONS

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 chainwheels on operators for butterfly, gate, and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Check Valves: In horizontal or vertical position, between flanges.

G. Valves shall be supported independent of piping system for valves 2 1/2" and larger.

H. Install shutoff-duty valves at each branch connection to supply mains, at sub-branch connections to branches if greater than 2 pieces of equipment are downstream, at supply and return connection to each piece of equipment, and as indicated on drawings.

I. Install calibrated-orifice, balancing valves at each branch connection to return main and as indicated on drawings.

J. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

K. Install check valves at each pump discharge and elsewhere as required to control flow direction.

L. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

M. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure. Exception: If makeup-water connection is indirect, pressure-reducing valve is not required.

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.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Globe valves.
4. Pump-Discharge Check Valves:
    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, metal or resilient-seat check valves.

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 and Larger: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. HDPE Piping, NPS 2 1/2" and Larger: Flanged ends.

3.5 HYDRONIC PIPING VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Ball Valves: Two piece, full port, bronze with bronze trim.
2. Bronze Swing Check Valves: Class 125, bronze disc.
3. Bronze Gate Valves: Class 125, NRS, bronze.
4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, stainless-steel or aluminum-bronze disc.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 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, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Continuous threaded rod shall be used wherever possible. An engineered cable support system is acceptable. Chain, wire, or perforated straps shall not be permitted.

D. Concrete inserts into poured concrete floor systems are permitted.

E. Beam clamps, trapeze hangers, and clevis hangers shall be permitted.

F. Supports from roof decking systems are not permitted.

G. Concrete inserts into precast concrete plank are permitted.

H. Powder activated fasteners are not allowed.

1.5 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. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

1.6 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.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

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

1. Buckaroos, Inc.
2. Carpenter and Paterson, Inc..
3. National Pipe Hanger Corporation.
4. Piping Technology & Products, Inc.
5. Rilco Manufacturing Co., Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, 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 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

C. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 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.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure. All hangers and supports shall be attached to the building structural steel system. Support from steel joist panel point is required.

B. All hangers, supports and fastening methods used shall be suitable for the weight of the components being supported.

C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58 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.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. 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.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

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 that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. 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 or trapzee.

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.

5. Pipes NPS 8 and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. 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 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.

3.4 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.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with G90 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 padded hangers for piping that is subject to scratching.

G. Use 360° formed thermal-hanger shield inserts for insulated piping and tubing.

H. 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. 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 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-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 or carbon-steel plate.
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 or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 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 two 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 24, 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.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: 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.

K. 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.

L. 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 or MSS SP-58 to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. 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 allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Vibration isolators.
2. Vibration isolation equipment bases.
3. Factory finishes.
4. Flexible piping connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each product.

1.4 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.5 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.

5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double deflection, elastomeric isolation mounts.

1. Resilient Material: Oil- resistant rubber, neoprene, or other elastomeric material.

D. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

E. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

F. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

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. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

2.4 FLEXIBLE PIPING CONNECTORS

A. Molded reinforced neoprene construction with steel flanges and control rods.

B. Flexible steel braided construction with steel flanges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Installation of vibration isolation, piping connections, and inertia bases shall be in accordance with the manufacturer’s recommendations.

C. Rigid connections between vibrating equipment and the building shall not be permitted.

D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

E. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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. Valve schedules shall be furnished by each respective Contractor and shall include the following items:

1. Valve Identification
2. Location
3. Purpose

1.4 QUALITY ASSURANCE

A. Identification requirements shall meet ASME A13.1.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS (Including Branch Selector labels.)

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White
3. Background Color: Red
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm).
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number,

C. 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

C. 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.

D. Fasteners: Stainless-steel rivets or self-tapping screws.

E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. 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 partially cover 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 DUCT LABELS

A. Provide one of the following:

1. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
2. Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Label characteristics:

a. Letter Color: White.
b. Background Color: Black.
c. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
d. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
f. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
g. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
h. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

A. Description: Metal or plastic stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Metal Tag Material: Brass, 0.032-inch (0.8-mm), stainless steel, 0.025-inch (0.64-mm), aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Plastic Tag Material: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware. Color per ANSI A13.1, minimum temperature rating of 160°F.
3. Fasteners: Brass wire-link chain or beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.

2.6 WARNING TAGS

A. Description: 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."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 BRANCH SELECTOR LABELS INSTALLATION

A. Install an equipment label as instructed above.

B. Provide label beneath every pair of refrigerant connectors. Labels shall indicate the fan coil it serves utilizing the name provided on the drawings. Spare inputs shall be labeled “SPARE”.

3.5 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.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:

1. Heating Water Piping: White letters on a safety-green background.
2. Refrigerant Piping: White letters on a safety-purple background.
3. Condensate: White letters on a safety-green background.

3.6 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green color: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels 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.

3.7 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 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 subparagraphs:

1. Valve-Tag Size and Shape:

a. Refrigerant: 1-1/2 inches (38 mm).
b. Heating Water: 1-1/2 inches (38 mm).

c. Gas: 1-1/2 inches (38 mm).

2. Valve-Tag Colors:

a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
b. Flammable Fluids: Black letters on a safety-yellow background.
c. Combustible Fluids: White letters on a safety-brown background.
d. Potable and Other Water: White letters on a safety-green background.
e. Compressed Air: White letters on a safety-blue background.

3.8 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
    b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
    a. Variable-flow hydronic systems.
3. Testing, Adjusting, and Balancing Equipment:
    a. Motors.
    b. Boilers.
    c. Heat-transfer coils.
4. Duct leakage tests.
5. Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 7 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. Sustainable Design Submittals:

1. See Section 018113 “Sustainable Design.”
2. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 90 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.7 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.8 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume and fire dampers are open and functional.
d. Clean filters are installed.

e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals and installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. For variable-air-volume systems, develop a plan to simulate diversity.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. 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.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

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

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air damper devices for each ducted grille or diffuser to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
d. Adjust controls so that terminal is calling for minimum airflow.
e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
f. Verify tracking between supply and return fans.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

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.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals, for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

6. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

7. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
8. Prior to verifying final system conditions, determine system differential-pressure set point.
9. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
10. Mark final settings and verify that memory stops have been set.
11. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

12. Verify that memory stops have been set.

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.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.10 PROCEDURES FOR BOILERS

A. Hydronic Boilers:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Record relief valve pressure setting.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:
1. Water flow rate.
2. Water pressure drop for major equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
3. Airflow.

3.12 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.13 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.

6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

3.14 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 5 percent.
3. Heating-Water Flow Rate: Plus or minus 5 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.15 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for 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.

3.16 FINAL REPORT

A. Draft “Pencil Copy” Report: Provide draft air balance report when the balancing is complete to the Engineer and Commissioning Authority for review before final report.

B. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

C. 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.

D. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings including settings and percentage of maximum pitch diameter.
    e. Settings for supply-air, static-pressure controller.
    f. Other system operating conditions that affect performance.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches (mm), and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches (mm), and bore.

f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat-coil static-pressure differential in inches wg (Pa).
g. Cooling-coil static-pressure differential in inches wg (Pa).
h. Heating-coil static-pressure differential in inches wg (Pa).
i. Outdoor airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm) o.c.
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Entering-water temperature in deg F (deg C).
i. Leaving-water temperature in deg F (deg C).

G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.

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

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Entering-air temperature in deg F (deg C).
c. Leaving-air temperature in deg F (deg C).
d. Air temperature differential in deg F (deg C).
e. Entering-air static pressure in inches wg (Pa).
f. Leaving-air static pressure in inches wg (Pa).
g. Air static-pressure differential in inches wg (Pa).
h. Low-fire fuel input in Btu/h (kW).
i. High-fire fuel input in Btu/h (kW).
j. Manifold pressure in psig (kPa).
k. High-temperature-limit setting in deg F (deg C).
l. Operating set point in Btu/h (kW).
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h (kW).

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm (L/s).
    b. Total system static pressure in inches wg (Pa).
    c. Fan rpm.
    d. Discharge static pressure in inches wg (Pa).
    e. Suction static pressure in inches wg (Pa).

I. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Apparatus used for test.
    d. Area served.
    e. Make.
    f. Number from system diagram.
    g. Type and model number.
    h. Size.
    i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm (L/s).
    b. Air velocity in fpm (m/s).
    c. Preliminary airflow rate as needed in cfm (L/s).
    d. Preliminary velocity as needed in fpm (m/s).
    e. Final airflow rate in cfm (L/s).
    f. Final velocity in fpm (m/s).
    g. Space temperature in deg F (deg C).

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling-unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm (L/s).
    b. Entering-water temperature in deg F (deg C).
    c. Leaving-water temperature in deg F (deg C).
    d. Water pressure drop in feet of head or psig (kPa).
    e. Entering-air temperature in deg F (deg C).
    f. Leaving-air temperature in deg F (deg C).

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.
    f. Water flow rate in gpm (L/s).
    g. Water pressure differential in feet of head or psig (kPa).
    h. Required net positive suction head in feet of head or psig (kPa).
    i. Pump rpm.
    j. Impeller diameter in inches (mm).
    k. Motor make and frame size.
    l. Motor horsepower and rpm.
    m. Voltage at each connection.
    n. Amperage for each phase.
    o. Full-load amperage and service factor.
    p. Seal type.

2. Test Data (Indicated and Actual Values):

    a. Static head in feet of head or psig (kPa).
    b. Pump shutoff pressure in feet of head or psig (kPa).
    c. Actual impeller size in inches (mm).
    d. Full-open flow rate in gpm (L/s).
    e. Full-open pressure in feet of head or psig (kPa).
    f. Final discharge pressure in feet of head or psig (kPa).
    g. Final suction pressure in feet of head or psig (kPa).
    h. Final total pressure in feet of head or psig (kPa).
    i. Final water flow rate in gpm (L/s).
    j. Voltage at each connection.
    k. Amperage for each phase.

L. Instrument Calibration Reports:

1. Report Data:

    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.17 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of commissioning authority.

B. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, Engineer may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

C. 11 month Warranty Walk: TAB contractor to perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to report unusual conditions with recommendation of adjustments. TAB Contractor shall allow two (2) days for this work.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation and jacketing for the following duct services:

1. Indoor, supply, return, exhaust, and outdoor air duct.
2. Outdoor, supply, return, exhaust, and outdoor air duct.

B. Related Sections:

1. Division 23 Section "HVAC Equipment Insulation."
2. Division 23 Section "HVAC Piping Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

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

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, dampers, specialties and flanges for each type of insulation.
3. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 6 inches square.
2. Sheet Jacket Materials: 6 inches square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.4 QUALITY ASSURANCE

A. All duct insulation and jacketing systems shall comply with SMACNA Standards.

B. All duct insulation and jacketing systems shall comply with Midwest Insulation Contractors Association (MICA), National Commercial and Industrial Insulation Standards, 7th Edition.

C. All duct insulation shall comply with the requirements of ASHRAE Standard 90.1.

D. Work shall be performed at the temperatures and humidity recommended by the product manufacturers.

E. 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.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

F. 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.

G. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Ductwork Mockups:
   a. One 10-foot (3-m) section each of rectangular and round straight duct.
   b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
   c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
   d. One rectangular and round transition fitting.
   e. Four support hangers for round and rectangular ductwork.
   f. Each type of damper and specialty.
2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

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

1.6 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.

1.7 DELIVERY AND STORAGE OF MATERIALS

A. Delivery: Deliver materials in manufacturer's original packaging.

B. Storage: Store and protect products in accordance with the manufacturer's instructions. Store in a dry indoor location. Protect insulation materials from moisture and soiling.

C. Do not install insulation that has been damaged or wet. Remove it from the jobsite.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with the requirements listed in "HVAC Duct Material Schedule" on drawings and "Duct Insulation Schedule" in this specification.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1290, Type III, to maximum service temperature of 250 deg F, and ASTM C1136, Type II, facing material.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:
   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite XG or Microlite Standard
   c. Knauf Insulation; Atmosphere Duct Wrap.
   d. Owens Corning; SoftR Duct Wrap FRK or White PSK
2. The duct wrap insulation shall consist of a blanket of glass or mineral fibers factory-laminated to a foil reinforced (FRK) or white poly scrim kraft (PSK) vapor retarder facing with a 2 inch (min.) stapling edge and taping flange on one edge.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ or AP facing/jacketing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include 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.

G. Flexible Elastomeric Insulation: Closed-cell, expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials. Insulation shall be provided with or without pressure sensitive adhesive in sheet or roll form.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:
   a. Armacell – Armatuff SA for exterior applications only
   b. Armacell – AP Armaflex FS for interior applications
   c. K-Flex, USA; Clad WT Sheet or AL Sheet
2. Elastomeric Core:
   a. Thermal Conductivity: 75 deg F mean temperature; 0.25 per ASTM C 177
   b. Water Vapor Permeability: 0.05 per ASTM E 96, Procedure A.
   c. Water Absorption, % by Volume: 0.2% or less per ASTM C 209.
   d. Product shall be tested for mold, fungi and bacterial resistance, passing value, per UL181, ASTM G21 and ASTM G22.
   e. Weatherability: Excellent per ASTM D471.
   f. Durability: Excellent per ASTM D1000.
   g. Use range of 180 deg F to -297 deg F per ASMT C534.
3. Factory applied jacket for exterior applications: Embossed laminate surface, requiring no painting, puncture resistant, UV resistant, minimum 12 mil thick.
   a. Color: White or aluminum.

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.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
   d. Mon-Eco Industries, Inc.; 22-25.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA, Inc.; Aeroseal.
   b. Armacell LLC; Armaflex 520 Adhesive.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.

C. FSK Jacket 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, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

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 on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.
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.
5. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.
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.

2.5 FIELD-APPLIED OUTDOOR JACKETS

A. Jacketing:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:
   a. Alumaguard; All-Weather.
   b. 3M VentureClad; 1579GCW.
   c. FlexClad; FlexClad-400
2. Material minimum thickness: 15 mils
3. Materials shall be compatible with insulation materials

4. Color: Aluminum
5. Adhesion: Self-adhering

2.6 TAPES

A. FSK and PSK Tape: Foil-face for FSK, white face for PSK, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.7 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1) GEMCO; Nylon Hangers.
   2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   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) GEMCO.
      2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

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. C & F Wire.

2.8 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

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. Insulation and insulation systems shall be installed in compliance with all insulation manufacturers' requirements and recommendations.

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

C. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

D. 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.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

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. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

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.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."
3. Seal annular space at non-rated floors with non-combustible materials.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over compress 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.

3. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
4. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
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.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over-compress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
3. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect or Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. The insulation contractor shall advise the general and/or mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period to avoid damage and deterioration of the finished insulation work. Insulation system shall be protected to prevent damage through duration of project.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Items not requiring insulation:

1. Fibrous-glass ducts.
2. Fabric ducts.
3. Double wall ducts.
4. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
5. Factory-insulated flexible ducts.
6. Factory-insulated plenums and casings.
7. Flexible connectors.
8. Vibration-control devices.
9. Factory-insulated access panels and doors.
10. Nameplates and data plates.
11. Supply duct exposed in the space it is conditioning.
12. Return duct in conditioned space or return plenum.

3.9 INDOOR DUCT INSULATION AND JACKETING SCHEDULE

A. Concealed, round, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket with FSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Flexible elastomeric: 1 inch thick.

B. Exposed, round, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket with PSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Mineral-Fiber board with ASJ or FSK: Nominal 2 inches thick and 3.0-lb/cu. ft. nominal density (installed minimum R value of 6.0).
3. Flexible elastomeric: 1 inch thick.

C. Concealed, round, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket with FSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Flexible elastomeric: 1 inch thick.

D. Exposed, round, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket with PSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density
2. Mineral-Fiber board with ASJ or FSK: Nominal 2 inches thick and 3.0-lb/cu. ft. nominal density (installed minimum R value of 6.0).
3. Flexible elastomeric: 1 inch thick.

E. Concealed (in plenum) and exposed, round, return-air duct insulation shall be the following:

1. None Required

F. Concealed (in unconditioned cavity), round, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket with FSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Flexible elastomeric: 1 inch thick.

G. Concealed and exposed, round, exhaust-air duct insulation shall be the following:

1. None Required

H. Exposed, round, exhaust-air duct insulation to the outdoors shall be the following:

1. Mineral-Fiber Blanket with PSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density
2. Mineral-Fiber board with ASJ or FSK: Nominal 2 inches thick and 3.0-lb/cu. ft. nominal density (installed minimum R value of 6.0).
3. Flexible elastomeric: 1 inch thick.

I. Concealed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket with FSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Flexible elastomeric: 1 inch thick.
3. Mineral-Fiber board with ASJ or FSK: Nominal 2 inches thick and 3.0-lb/cu. ft. nominal density (installed minimum R value of 6.0).

J. Exposed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket with PSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Flexible elastomeric: 1 inch thick.
3. Mineral-Fiber board with ASJ or FSK: Nominal 2 inches thick and 3.0-lb/cu. ft. nominal density (installed minimum R value of 6.0).

K. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket with FSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Flexible elastomeric: 1 inch thick.
3. Mineral-Fiber board with ASJ or FSK: Nominal 2 inches thick and 3.0-lb/cu. ft. nominal density (installed minimum R value of 6.0).

L. Exposed, rectangular, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket with PSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Flexible elastomeric: 1 inch thick.

3. Mineral-Fiber board with ASJ or AP: Nominal 2 inches thick and 3.0-lb/cu. ft. nominal density (installed minimum R value of 6.0).

M. Concealed and exposed, rectangular, return-air duct insulation shall be one of the following:

1. None Required.

N. Exposed, rectangular, exhaust-air duct insulation to the outdoors shall be the following:

1. Mineral-Fiber Blanket with PSK jacket: 2 inches thick and 1.5-lb/cu. ft. nominal density
2. Flexible elastomeric: 1 inch thick.
3. Mineral-Fiber board with ASJ or FSK: Nominal 2 inches thick and 3.0-lb/cu. ft. nominal density (installed minimum R value of 6.0).

3.10 OUTDOOR DUCT INSULATION AND JACKETING SCHEDULE

A. Outdoor duct insulation and jacketing shall comply with the following:

1. Comply with all manufacturer's written instructions. Fiber board insulation 2 inches thick, with embossed aluminum jacket. No mechanical fasteners, including but not limited to screws, nails, clips, and staples shall be used for installing aluminum jacketing. No such fasteners shall protrude through aluminum jacketing. Jacketing system shall be water-tight with all seams continuously sealed with adhesive. Install jacketing system per manufacturer's instructions. Insulation and jacketing shall be pitched to shed water and prevent ponding on top of the duct.

END OF SECTION 230713

SECTION 230716 - HVAC EQUIPMENT 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.

B. Related Sections:

1. Section 230713 "Duct Insulation."
2. Section 230719 "HVAC Piping Insulation."

1.2 ACTION SUBMITTALS

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

1.3 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.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 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 specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

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 segments that have satisfactory test results.

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

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Equipment Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:

   a. Armacell – Armatuff SA for exterior applications only
   b. Armacell – AP Armaflex FS for interior applications
   c. K-Flex, USA; Clad WT Sheet or AL Sheet

2. Elastomeric Core:

   a. Thermal Conductivity: 75 deg F mean temperature; 0.25 per ASTM C 177
   b. Water Vapor Permeability: 0.05 per ASTM E 96, Procedure A.
   c. Water Absorption, % by Volume: 0.2% or less per ASTM C 209.
   d. Product shall be tested for mold, fungi and bacterial resistance, passing value, per UL181, ASTM G21 and ASTM G22.
   e. Weatherability: Excellent per ASTM D471.
   f. Durability: Excellent per ASTM D1000.
   g. Use range of 180 deg F to -297 deg F per ASMT C534.

3. Factory applied jacket for exterior applications: Embossed laminate surface, requiring no painting, puncture resistant, UV resistant, minimum 12 mil thick.

   a. Color: White or aluminum.

A. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1290, Type III, to maximum service temperature of 250 deg F, and ASTM C1136, Type II, facing material.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:

   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite XG or Microlite Standard
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Owens Corning; SoftR Duct Wrap FRK or White PSK

2. The duct wrap insulation shall consist of a blanket of glass or mineral fibers factory-laminated to a foil reinforced (FRK) or white poly scrim kraft (PSK) vapor retarder facing with a 2 inch (min.) stapling edge and taping flange on one edge.

A. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ or AP facing/jacketing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include 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.

B. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied **ASJ** complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include 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.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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 and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:

   a. Armacell – Armatuff SA for exterior applications only
   b. Armacell – AP Armaflex FS for interior applications
   c. K-Flex, USA; Clad WT Sheet or AL Sheet

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."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

   a. Childers Brand, Fuller.
   b. Eagle Bridges, Marathon.
   c. Foster Brand, Fuller.
   d. Mon-Eco Industries.

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."

D. ASJ Adhesive, and FSK and PVDC Jacket 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, available products that may be incorporated into the Work include the following:

   a. Childers Brand, Fuller.
   b. Eagle Bridges, Marathon.
   c. Foster Brand, Fuller.
   d. Mon-Eco Industries.

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."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

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. 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).

A. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.
   c. Knauf.
   d. Childers.

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.
5. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

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 (Minus 40 to plus 121 deg C).
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).

7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

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

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

2.7 FIELD-APPLIED OUTDOOR JACKETS

A. Alumaguard:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:
   a. Polyguard – Alumaguard
   b. ITW Insulation Systems; Illinois Tool Works, Inc.
   c. RPR Products, Inc.

2.8 TAPES

A. FSK and PSK Tape: Foil-face for FSK, white face for PSK, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ABI, Ideal Tape Division; 491 AWF FSK.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   c. Compac Corporation; 110 and 111.
   d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
c. Alumaguard.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.
2) GEMCO.
3) Midwest Fasteners, Inc.
4) Nelson Stud Welding.

b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.

c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
2) GEMCO; Peel & Press.
3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

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) AGM Industries, Inc.
2) GEMCO.
3) Midwest Fasteners, Inc.
4) Nelson Stud Welding.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.10 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

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 and equipment 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. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) 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.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) 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.

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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Handholes.
5. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).

8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 inch (1.0 mm) thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.6 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: One finish coat over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 EQUIPMENT INSULATION SCHEDULE

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

B. Insulate indoor and outdoor equipment that is not factory insulated.

END OF SECTION 230716

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Heating hot-water piping, indoors.
   2. Refrigerant suction and hot-gas piping, indoors and outdoors.
   3. Condensate piping, indoors and outdoors.

B. Related Sections:

   1. Division 23 Section "HVAC Equipment Insulation."
   2. Division 23 Section "Duct Insulation."

1.2 QUALITY ASSURANCE

A. 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. Products must comply with NFPA 255 and UL 723.

   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.

B. Material shall be delivered in nonbroken, factory furnished packaging and stored in a clean, dry indoor space that provides protection against weather.

C. Insulation shall be applied by qualified personnel skilled in this trade in accordance with NAIMA (North American Insulation Manufacturers Association) recommendations.

D. Testing of the systems to be insulated shall have been completed, inspected, and approved by the Owner’s representative before the insulation is applied.

E. Insulation shall not be applied until all surfaces are clean, dry, and free of dirt, dust, grease, frost, moisture, and other extraneous elements.

F. Work shall be performed at the temperatures recommended by the product manufacturer.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. 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.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Flexible Elastomeric Insulation: Closed-cell, flexible elastomeric insulation. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex
    c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
2. Material shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2-deg F at a 75 deg F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518.
3. Material shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A.

E. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000-Degree Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. Adhesives shall be in compliance with manufacturer's recommended contact adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK and PVDC Jacket 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2.4 MASTICS

A. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.

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.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

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.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

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

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

2.7 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    c. RPR Products, Inc.; Insul-Mate.

2. Sheet and roll stock ready for shop or field sizing.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 2.5-mil- thick polysurlyn.
5. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.
6. Factory-Fabricated Fitting Covers:

    a. Same material, finish, and thickness as jacket.
    b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    c. Tee covers.
    d. Flange and union covers.
    e. End caps.
    f. Beveled collars.
    g. Valve covers.
    h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

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, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 428 AWF ASJ.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    c. Compac Corporation; 104 and 105.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. 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, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ABI, Ideal Tape Division; 370 White PVC tape.
    b. Compac Corporation; 130.

c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 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.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 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 top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

Q. Flexible Elastomeric Installation
1. Insulation shall be installed per manufacturer’s requirements for insulation type.

3.3 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. Comply with requirements in Division 07 Section "Penetration Firestopping" for 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 Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

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 not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
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. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Outdoor Piping
1. All outdoor exposed piping shall be provided with a non-tear jacket with UV protectant finish, per manufacturer’s requirements.
2. All outdoor exposed piping shall have the seams located on the lower half of the pipe.

3.6 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE 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; 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.

3.8 FINISHES

A. Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. Mineral-Fiber, Preformed Pipe, Type I:
   a. Nominal Pipe Size less than 1-1/2”: Insulation thickness to be 1.5 inches.
   b. Nominal Pipe Size 1-1/2” or greater: Insulation thickness to be 2.0 inches.

B. Refrigerant Suction and Hot-Gas Piping: Flexible elastomeric, 1 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric, 1 inch thick.

D. Condensate Piping: Insulation shall be one of the following:

1. Flexible Elastomeric: 1/2 inch thick.
2. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing: Insulation shall be the following:

1. Flexible Elastomeric: 1 inch thick with non-tear jacket

C. Condensate Piping: Insulation is not required.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed (to include, but not limited to, mechanical room spaces, corridors, multi-purpose room, etc.):

1. PVC: 30 mils thick.
2. Aluminum, Stucco Embossed: 0.040 inch thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. Aluminum, Stucco Embossed: 0.040 inch thick.

D. Piping, Exposed: Exposed piping includes piping on roof serving Condensing units, from roof opening to coil connection.

1. Aluminum, Stucco Embossed: 0.040 inch thick.

END OF SECTION 230719

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Specification "Section 017329 - Cutting and Patching" for work related to ICF wall penetrations.

C. Refer to Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

D. Refer to Division 23 Section “General Duty Valves for HVAC Piping” for valves associated with piping systems.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Air-vent piping.
5. Safety-valve-inlet and -outlet piping.
6. Air control devices, including air separator, expansion tanks, and air vents.
7. Hydronic piping specialties, including strainers and flex connectors.
8. Calibrated orifice balancing valves, automatic balancing valves

1.3 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 150 psig at 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Air-Vent Piping: 200 deg F.
5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 SUBMITTALS

A. Product Data: For each type of the following:

1. Pressure-seal fittings.

2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
3. Air control devices.
4. Chemical treatment.
5. Hydronic specialties.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. Detail locations of isolation valves and balancing valves within the system.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product:

1. Include construction details and material descriptions for hydronic piping specialties.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

B. Pressure-relief and safety-relief valves and pressure vessels bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME BPVC, Section VIII, Division 1.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

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.

1.8 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. S. P. Fittings; a division of Star Pipe Products.
   c. Victaulic

C. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

2.3 POLYPROPYLENE PIPE, FITTINGS, AND VALVES

A. Pipe shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no reworked or recycled materials except that generated in the manufacturer's own plant from resin of the same

specification from the same raw material. All pipe shall be made in an extrusion process. Hydronic hot water and heating piping shall contain a fiber layer to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

B. Fittings shall be manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no reworked or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

C. Valves shall be manufactured in accordance with the manufacturer’s specifications and shall comply with the performance requirements of ASTM F 2389 or CSA B137.11. The valves shall contain no reworked or recycled thermoplastic materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

D. All polypropylene pipe shall be wrapped and/or insulated with standard pipe insulation, field installed. The pipe wrap or insulation shall meet the requirements of CAN/ULC-S102.2-03 or ASTM E84. The system shall have a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless 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.

B. 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, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 GROOVED MECHANICAL-JOINT FITTINGS, COUPLINGS, AND SPECIALTIES:

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:
   a. Anvil International, Inc.
   b. Smith-Cooper
   c. Victaulic Co. of America

B. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

C. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

D. Subject to compliance, grooved butterfly valves, strainers, suction diffusers and specialties may be utilized on grooved piping.

E. Three flexible couplings that comply with requirements may be used in lieu of a flexible connector for vibration attenuation and stress relief on piping. The couplings shall be place in close proximity to the source of vibration.

2.6 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
   d. Victaulic Company.
2. PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
3. Two-piece ductile iron housing and elastomer gasket with manufacturer's Schedule 80 and Schedule 40 equivalent dimensions; one end with integral gripping teeth to connect PVC pipe and steel pipe dimensioned housing key on the other side to engage with standard grooved end steel pipe.

B. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
   d. NIBCO INC.
2. MSS SP-107, PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.7 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. A.Y. McDonald Mfg. Co.
   b. Capitol Manufacturing Company.
   c. Central Plastics Company.
   d. Hart Industries International, Inc.
   e. Jomar International, Ltd.
   f. Matco-Norca.
   g. Watts Regulator Co.
   h. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.

2. Description:
   a. Standard: ASSE 1079.
   b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C)..
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Matco-Norca.
   d. Watts Regulator Co.
   e. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.
2. Description:
   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C)
   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 the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
2. Description:
   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig.
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Elster Perfection.
b. Anvil.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Description:
a. Standard: IAPMO PS 66.
b. Electroplated steel nipple, complying with ASTM F 1545.
c. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

2.8 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries. (Basis of Design)
4. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- diameter gage glass, and slotted-metal glass guard.

D. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 125 psig.
3. Maximum Operating Temperature: Up to 350 deg F.
4. Manufacturer: See schedules on drawings
5. Model: See schedules on drawings.

2.9 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Manufacturer and Model: Metraflex LPD Y
2. Body: Cast iron with bolted cover
3. End Connections: Flanged ends
4. Strainer Screen: 40-mesh startup strainer, and perforated 304 stainless-steel strainer with .045” perforation.
5. CWP Rating: 125 psig.

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

2.10 PREFABRICATED PUMP DROP ASSEMBLIES

A. Prefabricated pump drop assemblies, which may include check valves, butterfly valves, strainers, suction diffusers, flexible couplings, headers, and grooved pipe, may be used in lieu of individual components.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armstrong Pumps, Inc.
   b. Anvil
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Flow Design Inc.
   e. Gerand Engineering Co.
   f. Griswold Controls.
   g. Taco.
   h. Victaulic

2.11 BRONZE, CALIBRATED-ORIFICE, BALANCING VALVES:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.

g. Tour & Andersson; available through Victaulic Company of America

2. Body:

a. Bronze, ball or plug type with calibrated orifice or venturi.
b. Ametal brass copper alloy, y-pattern, glob type.

3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE or Ametal.
6. End Connections: Threaded, soldered, or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style:

a. Lever, with memory stop to retain set position.
b. Multiple-turn digital readout handwheel and concealed memory feature with locking, tamper-proof setting.

9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

2.12 CAST-IRON, DUCTILE IRON, OR STEEL, CALIBRATED ORIFICE, BALANCING VALVES:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Flow Design Inc.
d. Gerand Engineering Co.
e. Griswold Controls.
f. Taco.
g. Tour & Andersson

2. Body: Cast-iron, ductile iron, or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE or ductile iron.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style:

a. Lever, with memory stop to retain set position.
b. Multiple-turn digital readout handwheel and concealed memory feature with locking, tamper-proof setting.

10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

2.13 AUTOMATIC FLOW CONTROL VALVES:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Flow Design Inc.
    b. Griswold Controls.
    c. Bell and Gossett.
    d. Red-White Valve Corporation.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. PP-R piping and fittings

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
4. PP-R piping and fittings

C. Makeup-water piping installed aboveground shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. PP-R piping and fittings (except exterior applications).

D. Condensate-Drain Piping, Indoors and Outdoors: Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type L, drawn-temper copper tubing with soldered or flared joints.
3. PP-R piping and fittings (except exterior applications).

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. All piping must be capped and sealed from contamination and debris throughout the construction cycle.

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 groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

M. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

P. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

Q. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

S. Install flanges or couplings in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

T. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

U. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

V. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "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 Division 23 Section "Common Work Results for HVAC."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Common Work Results for HVAC."

3.3 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Refer to drawings for additional specific pipe hanging requirements.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 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. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Install hangers for polypropylene piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.4 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, 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. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Tighten assembly according to manufacturer's written instructions. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.5 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 nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flanges kits.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

E. Install expansion tanks and the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3.7 INSTALLATION OF VALVES

A. Install calibrated-orifice balancing valve at each branch connection to return main.

B. Install calibrated-orifice, balancing valve in the return pipe of each heating or cooling terminal.

C. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

D. Install pressure-relief and safety-relief valves at hot-water generators and elsewhere as required by ASME BPVC. Pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME BPVC, Section VIII, Division 1, for installation requirements.

3.8 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on new hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 24 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Separately-coupled, in-line centrifugal pumps.

1.2 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

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.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.4 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.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

1.6 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Pumps: 1 year from substantial completion.

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 SEPARATELY COUPLED IN-LINE CENTRIFUGAL PUMPS

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

1. Armstrong Pumps, Inc.
2. Bell & Gossett.
3. Crane Pumps & Systems.
4. Grundfos/PACO. (Basis of Design)
5. ITT Corporation.
6. Peerless Pump Company.
7. Patterson.
8. TACO Comfort Solutions, Inc.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and flanged connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT or Viton bellows and gasket. Include water slinger on shaft between motor and seal.
5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Permanently lubricated ball bearings.

7. Use shaft grounding rings when pump installed with VFD.

D. Shaft Coupling: Axially split spacer coupling.

E. Motor: Electrically Commutated.

1. 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. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   a. Service Factor: 1.15.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install suction diffuser and shutoff valve on suction side of pumps.

F. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 ALIGNMENT

A. Perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 RELATED DOCUMENTS

A. Refer to Specification "Section 017329 - Cutting and Patching" for work related to wall penetrations.

1.3 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Refrigerant piping.
2. Condensate-drain piping.

1.4 PERFORMANCE REQUIREMENTS

A. Single continuous lengths of pre-insulated Line Sets up to 100 feet to prevent additional connection points between equipment.

B. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig.
2. Hot-Gas and Liquid Lines: 225 psig.

C. Line Test Pressure for Refrigerant R-410a:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Hot-Gas and Liquid Lines: 535 psig.

1.5 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 ACTION SUBMITTALS

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

B. Warranty Certificate.

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 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
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 REFRIGERANTS

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. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. R-410a, R-134a

2.3 UNIBODY DESIGN BALL VALVES

A. Fully factory assembled

B. Single piece “Unibody” design to eliminate most welded joints.

C. Furnace brazed and pressure tested.

D. Each ball valve is equipped with Schrader Valve for refrigerant service; valve rated to 700 psi.

E. Seal cap design permits valve operation without removal of seal cap.

F. Teflon® seals and gaskets (no synthetic O-rings).

G. Forged brass body and seal cap.

H. One year limited materials and workmanship warranty on Ball Valves

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 brazed joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

D. Condensate-Drain Piping, Indoors and Outdoors: Type L, drawn-temper copper tubing, wrought-copper fittings, and 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 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.

G. 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.

H. 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.

I. 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.

J. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

K. 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. Intermediate traps required at 15 feet from base of suction riser.

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. Install piping adjacent to machines to allow service and maintenance.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Refer to unit specifications for solenoid valve controllers, control wiring, and sequence of operation.

L. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

M. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

N. Install refrigerant piping in protective conduit where installed belowground.

O. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

P. 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.

Q. When brazing, 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.

R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

S. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. 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 Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Provide Padded Hangers for Horizontal support.

1. Glue 3/8 inch flexible elastomeric insulation to top of pipe hanger.

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.

2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.

D. Install vertical clamp style support for vertical runs longer than 4 feet.

1. Support Every 8 feet with a minimum of 2 supports on any vertical run longer than 4 feet.
2. Provide 1-5/8” unistrut secured to the wall for vertical support.
3. Provide insulation pipe hangers at supports at clamp.
   a. Clamps must incorporate CFC-free PUR/PIR load-bearing segments embedded in the insulation.
   b. Outer shells shall be 30 mils thick painted aluminum
   c. Basis of Design: Armafix Insulated Pipe Hanger (Armacell)

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 232513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Manual chemical-feed equipment.
2. HVAC water-treatment chemicals.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. TDS: Total dissolved solids.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Manual chemical feed equipment.
2. Chemical test equipment.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all equipment to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section. Chemicals, equipment, testing services, and chemical application shall be supplied by a single water treatment company for undivided responsibility. The water treatment company shall be a recognized specialist, active in the field of commercial/industrial water treatment for at least 5 years, and have Certified Water Technologist Certification. The water treatment company shall have regional water analysis laboratories, service department, and full time representatives located within the trading area of the job site or facility.

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.

1.8 WARRANTY

A. Provide a 1 year service program including testing and required material and maintenance. Chemical feed systems shall include all chemicals and additives.

1.9 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for hydronic water piping system and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Regularly scheduled service visits each week for the initial four weeks after initial charging of the system(s) and checking all parameters listed under PERFORMANCE REQUIREMENTS items 1-9. Subsequently monthly service calls checking items 1-5 during the first year of substantial completion provided that all other parameters are within specified ranges.
6. Laboratory technical analysis.

7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

B. Provide filter media as necessary to maintain the required water quality over the installation, start-up, and warranty periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Providers: Subject to compliance with requirements, manufacturers and/or chemical service companies offering products/services that may be incorporated into the Work include, but are not limited to, the following:

1. Ampion Corp.
2. Anderson Chemical Company
3. Aqua-Chem, Inc.; Cleaver-Brooks Div.
4. Barclay Chemical Co.; Water Management, Inc.
5. Cascade Water Services, Inc.
6. Chardon Labs.
7. Earthwise Environmental Inc.
8. General Electric Company; GE Water & Process Technologies.
9. Hydro Phase Services.
10. Metro Group, Inc. (The).
11. Nalco; an Ecolab company.
12. Watcon, Inc.
13. J.S. Wingert
14. Solid Blend Technologies

2.2 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including ground-loop water, chilled water, heating hot water, and dual-temperature water, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. 800-1200 PPM Sodium Nitrite as $NaNO_2$.
4. Boron: Maintain a value within 100 to 200 ppm.
5. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
6. Soluble Copper: Maintain a maximum value of 0.20 ppm.
7. Soluble Iron: maximum value of 1.0 ppm.
8. Conductivity: Maximum value of 5,000 µS

9. TSS: Maintain a maximum value of 10 ppm.
10. Ammonia: Maintain a maximum value of 20 ppm.
11. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
12. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    d. Sulfate Reducers: Maintain a maximum value of zero organisms/mL.
    e. Iron Bacteria: Maintain a maximum value of zero organisms/mL.

2.3 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: CF-1: Carbon steel body, self supported, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
   1. Capacity: 5 gal.
   2. Pleated Filter, minimum 5 micron cartridge.
   3. Minimum Working Pressure: 125 psig.
   4. Basis of Design: Wheatley Model VFT-005-F.

B. Water Meter: Solid Blend Technology or equal.

2.4 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Bypass Feeders: Install in closed hydronic systems and equipped with the following:
   1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
   2. Install a full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
   3. Install a swing check on inlet after the isolation valve.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 232113 "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523 "General-Duty Valves for HVAC Piping."

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. 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.

C. Tests and Inspections:
   1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
   2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
   3. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
   4. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   5. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   6. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
   7. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. Comply with ASTM D 3370 and with the following standards:
   1. Silica: ASTM D 859.
   2. Acidity and Alkalinity: ASTM D 1067.
   3. Iron: ASTM D 1068.
   4. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 232500

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.

B. Refer to Specification "Section 017329 - Cutting and Patching" for work related to ICF wall penetrations.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233716 "Fabric Ducts" for fabric ductwork.
3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. 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"

C. 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. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 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 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

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 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 static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

I. 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.

2.4 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", inclusive of ASTM C534.

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. CertainTeed Corporation; Insulation Group.
b. Johns Manville.
c. Knauf Insulation.

d. Owens Corning.
e. Maximum Thermal Conductivity:

1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. 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.

3. 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. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

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. Aeroflex USA Inc.
b. Armacell LLC.
c. Rubatex International, LLC

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

a. 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).

C. Insulation Pins and Washers:

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.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

D. 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. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

10. 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).
11. 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."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. 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).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. 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. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 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.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for 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" unless otherwise indicated.

C. Install round 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 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 non-fire-rated interior assemblies and are not exposed to view, fill the opening between the assembly and the duct or duct insulation or jacketing with plenum-approved foam-in-place sealant or fiberglass insulation.

L. 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.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

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 DUCT SEALING

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

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

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.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
   a. Supply Ducts: Test representative duct sections totaling no less than 50 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.

3.8 DUCT CLEANING

A. Clean duct systems 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 and 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.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
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.

3.9 START UP

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

3.10 DUCT SCHEDULE

A. Refer to drawings for double-wall duct locations.

B. Fabricate ducts with galvanized sheet steel except as otherwise indicated in Specifications and Drawings and as follows:

C. Supply Ducts:

1. Ducts directly downstream of Terminal Units:

    a. Pressure Class: Positive 2-inch wg.
    b. Minimum SMACNA Seal Class: B.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round: 12.

2. Ducts directly downstream of Air-Handling Units:

    a. Pressure Class: Positive 4-inch wg.
    b. Minimum SMACNA Seal Class: B.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round: 6.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive 2-inch wg.
    b. Minimum SMACNA Seal Class: B.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Return Ducts:

1. Ducts Connected to Air-Handling Units:

    a. Pressure Class: Positive or negative 3-inch wg.
    b. Minimum SMACNA Seal Class: B.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round: 6.

2. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive or negative 3-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive or negative 3-inch wg.
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive or negative 3-inch wg.
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

G. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

H. Liner:

1. Return/Supply Air Ducts: Fibrous glass, Type I, 1 inch thick. Return air ducts shall be lined at the following locations:
   a. From DOAS, AHU, and RTU return/exhaust intake connection to minimum 10'-0" of duct run.
   b. Where indicated on drawings **for sound attenuation only.**

2. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Welded or flanged.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

   a. Velocity 1500 fpm or Lower: Conical tap.
   b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233116 - NONMETAL 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. Phenolic-foam ducts and fittings.

B. Related Requirements:

1. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Phenolic-foam duct materials.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevation of top of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated, smoke-rated, and other partitions.
9. Fire and smoke damper locations.
10. Equipment installation based on equipment being used on Project.
11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal: For nonmetal ducts, signed and sealed by a qualified professional engineer.

1. Duct materials and thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design calculations for selecting hangers and supports.

1.4 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, including electrical, plumbing, fire protection, and other building services. Indicate proposed changes to duct layout.
2. Structural members to which duct will be attached.
3. Size and location of initial access modules for acoustical tile.

B. Field quality-control reports.

1.5 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/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including duct closure, reinforcements, and hangers and supports, shall comply with the following and with the Works' performance requirements and design criteria:

1. SMACNA's "Phenolic Duct Construction Standards."
2. Static-Pressure Classes:

a. Supply and Outdoor Air Ducts 2-inch wg (500 Pa).
b. Return Ducts (Negative Pressure): 1-inch wg (250 Pa).
c. Exhaust Ducts (Negative Pressure): 1-inch wg (250 Pa).

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions to comply with ASCE/SEI 7.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1, Section 5.4 - "Airstream Surfaces."

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

2.2 PHENOLIC-FOAM DUCTS AND FITTINGS

A. Manufacturers:

1. Kingspan Koolduct (Indoor) and Thermaduct (Outdoor)
2. AQC Industries
3. PTM Dual-Tech

B. Duct Panel: CFC-free phenolic-foam bonded on both sides with factory-applied, 0.001-inch-(0.025-mm-) thick, aluminum foil reinforced with fiberglass scrim.

1. Temperature Limits:

a. Maximum 176 deg F (80 deg C).
b. Minimum: Minus 4 deg F (Minus 20 deg C).

2. Maximum Thermal Conductivity: 0.15 Btu x in./h x sq. ft. x deg F (0.021 W/m x K) at 75 deg F (24 deg C) mean temperature.
3. Permeability: 0.0002 perms (0.0115 ng/Pa x s x sq. m) maximum when tested according to ASTM E 96/E 96M, Procedure A.
4. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems.
5. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C 423, Mounting A.
6. Fire/Smoke Resistance: Duct material shall comply with UL 181, Class 1, maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL according to ASTM E 84.
7. Required Markings: UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for closure materials.
8. Cladding for outdoor duct: Vinyl Cladding: Minimum 0.032 inch (0.813 mm) thick.

C. Closure Materials:

1. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by manufacturer with coding "181A-P," manufacturer's name, and a date code.

a. Tape: Aluminum foil tape imprinted with listing information.
b. Minimum Tape Width: 3 inches (76 mm).
c. Water resistant.
d. Mold and mildew resistant.

2. Polymeric Sealing System:

a. Structural Membrane: Woven glass fiber.
b. Minimum Tape Width: 3 inches (76 mm).
c. Sealant: Water based.
d. Color: White.
e. Water resistant.
f. Mold and mildew resistant.

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according manufacturer's written instructions.

2. Fabricate 90-degree mitered elbows to include turning vanes.

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Zinc-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.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

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 duct sections in maximum practical lengths with fewest possible joints.

C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Install ducts with a minimum clearance of 1 inch (25 mm), plus allowance for insulation thickness.

G. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

H. 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. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

I. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code and by authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the fire damper UL listing.

J. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

L. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes, and 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.

M. Branch Connections: Use lateral or conical branch connections.

N. Install phenolic-foam ducts and fittings to comply with SMACNA's "Phenolic Duct Construction Standards."

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for phenolic-foam ducts and fittings to comply with SMACNA's "Phenolic Duct Construction Standards" Ch. 6, "Hangers and Supports" and with manufacturer's written instructions.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. 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 (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Where static pressure and leakage values shown below differ from those in the SMACNA manual, the more stringent values shall apply.
3. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.

4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.

F. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of Phenolic-foam, Thermoset FRP, PVC, and CPVC duct systems chosen randomly by Owner, for cleanliness according to "Method 3 - NADCA Vacuum Test."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

G. Duct system will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

3.4 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 duct as recommended by duct 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.

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 (or larger) particles.

2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. 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.
2. 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.
3. Coils and related components.
4. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
5. Supply-air ducts, dampers, actuators, and turning vanes.
6. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. All duct cleaning shall be performed according to NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
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 ducts or duct accessories.
4. Clean fibrous-glass duct with HEPA vacuuming equipment; do not permit duct to get wet. Replace fibrous-glass duct 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 washdown 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 removing surface deposits and debris.

3.5 STARTUP SERVICE

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

3.6 DUCT SCHEDULE

A. Indoor Ducts and Fittings: Use one of the following:

1. Metal ductwork. See specification 233113.
2. Phenolic-Foam Rectangular Ducts and Fittings:

a. Minimum Panel Thickness: [7/8 inch (22 mm)] [1-3/32 inches (28 mm)].
b. Joints: Secure joints according to duct manufacturer's written instructions.
c. Sealing: Seal joints according to duct manufacturer's written instructions.

B. Outdoor Ducts and Fittings, including ductwork routed down shaft adjacent to elevator:

1. Provide suitable external surface protection as recommended by manufacturer.
2. Phenolic-Foam Rectangular Ducts and Fittings:

a. Minimum Panel Thickness: [7/8 inch (22 mm)] [1-3/32 inches (28 mm)].
b. Vinyl Cladding: Minimum 0.032 inch (0.813 mm) thick.
c. Joints: Secure joints according to duct manufacturer's written instructions.
d. Sealing: Seal joints according to duct manufacturer's written instructions.

END OF SECTION 233116

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Ceiling radiation dampers.
5. Smoke dampers.
6. Combination fire and smoke dampers.
7. Corridor dampers.
8. Flange connectors.
9. Turning vanes.
10. Duct-mounted access doors.
11. Duct access panel assemblies.
12. Flexible connectors.
13. Flexible ducts.
14. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: Hat-shaped, 0.063-inch- thick extruded aluminum, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, end pivoted, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene mechanically locked.

I. Blade Axles:

1. Material: Aluminum.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20 gage minimum.
    b. Sleeve Length: 6 inches minimum.
5. Screen Mounting: Rear mounted.
6. Screen Material: Aluminum.
7. Screen Type: Insect.
8. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
    a. Ruskin Company.
    b. Semco
    c. Trox USA Inc.
2. Comply with AMCA 500-D testing for damper rating.

3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:

    a. Hat shaped.
    b. 0.094-inch- thick, galvanized sheet steel.
    c. Mitered and welded corners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized, roll-formed steel, 0.064 inch thick.

7. Blade Axles: Galvanized steel.
8. Bearings:

    a. Molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals: Neoprene.
10. Jamb Seals: Cambered aluminum.
11. Tie Bars and Brackets: Aluminum.
12. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.
    b. Provide a 2” standoff with spring locking positioner.

B. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. American Warming and Ventilating.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. Type: Static rated and labeled according to UL 555 by an NRTL.

A. Type: Dynamic and rated and labeled according to UL 555 by an NRTL.

B. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

C. Hour rating of fire damper shall be 1.5 times the hour rating of the penetrated fire barrier.

D. Frame: 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 (3.5 mm) or 0.39 inch (9.9 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.024-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. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.6 CEILING RADIATION DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Pottorff.
2. Nailor Industries Inc.
3. Ruskin Company.

B. General Requirements:

1. Labeled according to UL 555C by an NRTL.
2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

F. Fire Rating: As required.

2.7 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Pottorff.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.

E. Blades: Roll-formed, horizontal, interlocking or overlapping, minimum 0.063-inch-thick, galvanized sheet steel.

F. Leakage: Class I.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application.

I. Damper Motors: two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).

6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 24 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches, damper mounted.

2.8 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Pottorff.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.

F. Heat-Responsive Device: Resettable, 165 deg F rated, fire-closure device.

G. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

H. Smoke Detector: Integral, factory wired for single-point connection.

I. Blades: Roll-formed, horizontal, 0.063-inch-thick, galvanized sheet steel.

J. Leakage: Class I.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: two-position action.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 24 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches, damper mounted.

2.9 CORRIDOR DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Pottorff.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-hour or 1-1/2-hour rating by an NRTL.

C. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.

E. Blades: Roll-formed, horizontal,, 0.034-inch-thick, galvanized sheet steel.

F. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application.

G. Damper Motors: two-position action.

H. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

2.10 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.11 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.12 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.13 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.14 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.15 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: 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.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. 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.

2.16 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated. Refer to drawing for type.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body plus Ladder Access: 25 by 17 inches.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect diffusers or light troffer boots to ducts directly or with maximum 48-inch lengths of flexible duct clamped or strapped in place.

N. Connect flexible ducts to metal ducts with metal bands.

O. Install duct test holes where required for testing and balancing purposes.

P. Installation:

   1. Install ducts fully extended.
   2. Do not bend ducts across sharp corners.
   3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
   4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
   5. Install flexible ducts in a direct line, without sags, twists, or turns.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.
2. Ceiling mounted ventilators.

1.2 SUBMITTALS

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

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Fan speed controllers.

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.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

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

1. Aerovent; a division of Twin City Fan Companies, Ltd.
2. Greenheck Fan Corporation. (Basis of Design)
3. Loren Cook Company.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Downblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.
3. Pitch Mounting: Manufacture curb for roof slope.
4. Metal Liner: Galvanized steel.

E. Capacities and Characteristics: Refer to schedule on drawings.

F. Accessories:

1. Bird Screens: Removable, 1/2-inch mesh, aluminum wire.
2. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
3. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
4. Thermostat as required by schedule notes or controls schematic

2.2 CEILING-MOUNTED VENTILATORS

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

1. Broan
2. Greenheck Fan Corporation. (Basis of Design)
3. Loren Cook Company.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories (reference schedule notes and control schematics for controllability per fan):

1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
3. Motion Sensor: Motion detector with adjustable shutoff timer.
4. Isolation: Internal.

G. Capacities and Characteristics: See drawings

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.4 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Division 07 Section "Roof Accessories" for installation of roof curbs.

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

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."

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Lubricate bearings.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Ceiling diffusers.
2. Linear adjustable slot diffusers.
3. Round cone diffuser
4. Registers and grilles.

B. Related Sections:

1. Section 089000 "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Verification: For custom color air devices, submit in manufacturer's standard sizes to verify color selected. One sample for each custom color selected is required.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Square Plaque Ceiling Diffusers:

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

   a. Nailor Industries Inc.
   b. Price Industries
   c. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: 22-gauge steel.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches or 12 by 12 inches, refer to drawings.
6. Face Style: Plaque.
7. Border: Select border type based on ceiling type diffuser is to be installed in.

2.2 LINEAR ADJUSTABLE SLOT DIFFUSERS

A. Linear Adjustable Slot Diffusers:

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

   a. Nailor Industries Inc.
   b. Price Industries
   c. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Diffuser: Extruded aluminum.
4. Material - Pattern Controller: Extruded aluminum.
5. Finish - Diffuser Interior Surfaces Exposed to View: Baked enamel, black.
6. Finish - Diffuser Exposed Flanges: Custom color selected by Architect.
7. Finish - Pattern Controller: Baked enamel, black.
8. Accessories: Factory engineered insulated plenum

2.3 ROUND CONE DIFFUSERS

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

   a. Nailor Industries Inc.

b. Price Industries
c. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Diffuser: Extruded aluminum.
4. Finish: Baked enamel, color selected by Architect.

2.4 REGISTERS AND GRILLES

A. Louvered Supply/Return Grille:

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

a. Nailor Industries Inc.
b. Price Industries.
c. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: 45° louver return.
5. Core Construction: 3/4” blade spacing.
6. Frame: 1 3/4” inches wide.
7. Border: Select border type based on wall type diffuser is to be installed in.
8. Accessories: Aluminum opposed-blade damper.
9. Supply grilles shall have double deflection blades.

B. Duct Mounted Grilles:

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

a. Nailor Industries Inc.
b. Price Industries.
c. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Supply grilles shall have double deflection blades.
5. Height shall be compatible with duct diameter.
6. Accessories:
   a. Aluminum opposed-blade damper.
   b. Air scoop

C. Egg Crate Grilles:

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

a. Anemostat Products, a Mestek Company
b. Hart & Cooley Inc.
c. Krueger.

d. Nailor Industries Inc
e. Price Industries.
f. Titus.
g. Tuttle & Bailey.

2. Border: Select border type based on ceiling type in which diffuser is to be installed.
3. Finish: White powder coat.

2.5 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hooded, Roof Mounted Gravity Intake/Relief Ventilators

1.3 PERFORMANCE REQUIREMENTS

A. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which roof curbs and ventilators will be attached.
2. Sizes and locations of roof openings.

1.6 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 HOODED, ROOF MOUNTED GRAVITY INTAKE/RELIEF VENTILATORS

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

1. Acme Engineering & Mfg. Corporation.
2. Aerovent.
3. Greenheck Fan Corporation. (Basis of design)
4. Loren Cook Company.
5. PennBarry.

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.

C. Materials: Aluminum sheet, minimum 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Built-in cant and mounting flange. Coordinate with general trades contractor.
2. Overall Height: 12 inches.
3. Curb to include damper tray.

E. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

F. Galvanized-Steel Sheet Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

G. Accessories:

1. Hinged Base (on units with throat lengths less than 73")
2. Anti-condensate coat.
3. Gravity backdraft damper. Damper shall be installed in damper tray located in roof curb.
4. 12" Extended throat.

H. Capacities and Characteristics: Refer to Schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install gravity ventilators with clearances for service and maintenance.

C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.

E. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 235123 - GAS VENTS

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. Listed double-wall vents.

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 product.

B. Shop Drawings: For vents.

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. Detail fabrication and assembly of hangers and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

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

1. Heat-Fab, Inc.
2. Metal-Fab, Inc.
3. Selkirk Corporation.
4. Z-Flex; a division of the Novaflex Group.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.

D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

E. Outer Jacket: Aluminized or stainless steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Special Gas Vent: Condensing gas appliances.

3.3 INSTALLATION OF LISTED VENTS

A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Lap joints in direction of flow.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 235123

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes gas-fired, fire-tube and water-tube condensing boilers, trim, and accessories for generating hot water.

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 boilers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Sustainable Design Submittals:

1. Product Data: For energy performance.

C. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, mounting, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

D. Product Certificates:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
2. CSA B51 pressure vessel Canadian Registration Number (CRN).

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
1. Verify available warranties and warranty periods for units and components.
2. Leakage and Materials: 10 years from date of Substantial Completion.
3. Pressure Vessel or Heat Exchanger Damaged by Thermal Stress and Corrosion: 10 years from date of Substantial Completion.
4. Thermal Shock: Lifetime of boiler.
5. Defective Parts: 12 months from date of startup.
6. Burner: 5 years from date of shipment from factory.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.

E. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

F. CSA Compliance: Test boilers for compliance with CSA B51.

G. Boiler must have a minimum thermal efficiency of 88 percent at 120 degrees Fahrenheit.

2.2 FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

A. Boilers scheduled on drawings are existing to be installed and used in the hvac renovation. Provide with controls and Boiler Management system per this specification. Install in compliance with applicable codes and standards and the requirements of this specification.

2.3 TRIM

A. Include devices sized to comply with ASME B31.1 OR ASME B31.9.

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end gate valve.

G. Acid Neutralization Kit

2.4 CONTROLS

A. Refer to Specification 250000 Section, "Building Automation Systems."

B. Refer to drawings “Sequence of Operations for HVAC Controls” for boiler control sequence.

C. Boiler plant shall have central BACnet compatible control panel provided by the boiler manufacturer.

D. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.
3. Motorized isolation valve control.
4. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate.

    a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

    b. O2 compensation: Closed loop O2 trim.

E. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Blocked Exhaust Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
5. High Condensate: Prevent operation in the event of a blocked condensate drain.
6. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

F. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

a. Monitoring: On/off status, common trouble alarm.
b. Control: On/off operation, hot-water-supply temperature set-point adjustment.

2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to nonfused disconnect switch provided by manufacturer.
5. Provide each motor with overcurrent protection.

2.6 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, galvanized steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Boiler Venting:

1. Install flue venting kit and combustion-air intake.
2. Connect full size to boiler connections. Comply with requirements in Section 235123 "Gas Vents."

I. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion as needed.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Boiler will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain boilers.

B. Record video of training and provide to owner with closeout submittals.

END OF SECTION 235216

SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Compressor and condenser units, air cooled, 1 to 5 tons (3.5 to 17.6 kW).
2. Compressor and condenser units, air cooled, 6 to 120 tons (21 to 422 kW).

1.3 ACTION SUBMITTALS

A. Product Data: For each compressor and condenser unit.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
2. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Shop Drawings: For compressor and condenser units.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For compressor and condenser units indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. 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.
2. Design Calculations: Calculate requirements for selecting vibration isolatorsand for designing vibration isolation bases.
3. Calculate requirements for selecting vibration isolatorsand wind restraints and for designing vibration isolation bases.
4. Indicate compliance with "Performance Requirements" Article.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Startup service reports.

C. Field quality-control reports.

D. Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

1.6 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

B. Coordinate location of piping and electrical rough-ins.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.
b. Condenser coil leak.

2. Warranty Period: Five years from date of Substantial Completion.
3. Warranty Period (Compressor Only): Five- years from date of Substantial Completion.
4. Warranty Period (Components Other Than Compressor): Five years from date of Substantial Completion.
5. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolationand wind restraints.

B. Wind-Restraint Performance:

1. See [Section 230548.13 "Vibration Controls for HVAC Piping and Equipment"] for requirements.

C. Fabricate and label refrigeration system in accordance with ASHRAE 15 and ASHRAE 34.

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."

E. 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 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 1 TO 5 TONS (3.5 TO 17.6 kW)

2.3 MANUFACTURERS

A. Available Manufacturers include:

1. Carrier Corporation– Basis of Design
2. Trane
3. Daikin

B. Description: Factory assembled and tested; consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

C. Compressor Type: Scroll, hermetically sealed, with rubber vibration isolators.

1. Motor: [Two] speed, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
2. Two-Speed Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
3. Accumulator: Suction tube.

D. Refrigerant: R-410A.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil; with removable drain pan and brass service valves with service ports.

F. Condenser Fan: Direct-drive, metal propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection.

G. Accessories:

1. Crankcase heater.
2. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
3. Low-voltage thermostat and subbase to control compressor and condenser unit and evaporator fan.
4. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
5. Filter-dryer.
6. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
7. Liquid-line solenoid.
8. Low-Ambient Controller:

    a. Cycles condenser fan to permit operation down to [35 deg F (2 deg C)] .
    b. Controls condenser fan speed to permit operation down to minus 20 deg F (minus 29 deg C) with time-delay relay to bypass low-pressure switch.

9. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
10. Plastic mounting base.

11. Precharged and preinsulated suction and liquid tubing.
12. Sound Hood: Wraps around sound attenuation cover for compressor.
13. Thermostatic expansion valve for installation at evaporator coil.
14. Fixed orifice for installation at evaporator coil.
15. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
16. Reversing valve.

H. Unit Casing: Galvanized steel, finished with baked enamel or baked powder-coat; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gauge ports on exterior of casing.

I. Capacities and Characteristics: See Schedules on Drawings

2.4 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 6 TO 120 TONS (21 TO 422 kW)

2.5 MANUFACTURERS

A. Available Manufacturers include:

1. Carrier Corporation– Basis of Design
2. Trane
3. Daikin

B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

C. Compressor:

1. Hermetic scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.

a. Capacity Control: Hot-gas bypass.

D. Refrigerant: R-407C or R-410A.

E. Condenser Coil: Seamless copper-tube or aluminum microchannel-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve.

1. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.
2. Provide factory-applied anti-corrosion coating to assembled coil.

F. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:

1. Permanently lubricated, ball-bearing motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.

G. Operating and safety controls include the following:

1. Manual-reset, high-pressure cutout switches.
2. Automatic-reset, low-pressure cutout switches.

3. Low-oil-pressure cutout switch.
4. Compressor-winding thermostat cutout switch.
5. Three-leg, compressor-overload protection.
6. Control transformer.
7. Magnetic contactors for compressor and condenser fan motors.
8. Timer to prevent excessive compressor cycling.

H. Accessories:

1. Low-voltage thermostat and subbase to control compressor and condenser unit and its associated evaporator fan.

2. Gauge Panel: Package with refrigerant circuit suction and discharge gauges.
3. Hot-gas bypass kit.
4. Part-winding-start timing relay, circuit breakers, and contactors.
5. Vibration isolation mounts.

I. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:

1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.

2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
3. Gasketed control panel door.
4. Condenser coil hail guard

J. Capacities and Characteristics: See Schedules on Drawings

2.6 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.7 SOURCE QUALITY CONTROL

A. Performance Ratings: Certify capacity performance ratings of compressor and condenser units in accordance with AHRI 340/360.

B. Sound-Power Level Ratings: Factory test sound-power-level ratings in accordance with AHRI 270.

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 compressor and condenser units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated.

B. Install roof-mounting units on equipment supports specified on detail drawings.

C. Equipment Mounting:
1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC Piping and Equipment."

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install piping specialties, electrical components, devices, and accessories that are not factory mounted.

3.3 PIPING CONNECTIONS

A. Comply with requirements for piping in Section 232113 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

D. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions and perform the following:

a. Inspect for physical damage to unit casing.
b. Verify that access doors move freely and are weathertight.
c. Clean units and inspect for construction debris.
d. Verify that all bolts and screws are tight.
e. Adjust vibration isolation and flexible connections.
f. Verify that controls are connected and operational.

B. Start unit in accordance with manufacturer's written instructions and complete manufacturer's startup checklist.

C. Measure and record airflow and air temperature rise over coils.

D. Verify operation of condenser capacity control device.

E. Verify that vibration isolation and flexible connections prevent vibration transmission to structure.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify manufacturer's required airflow over coils.

D. Verify that vibration isolation and flexible connections prevent vibration transmission to structure.

E. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 DEMONSTRATION

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

END OF SECTION 236200

SECTION 237200 - AIR-TO-AIR ENERGY RECOVERY 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. Packaged energy recovery units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For air-to-air energy recovery equipment. 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 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

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. Filters: **One** set of each type of filter specified.
   2. Fan Belts: **One** set of belts for each belt-driven fan in energy recovery units.
   3. Wheel Belts: **One** set of belts for each heat wheel.

1.6 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. ARI Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."

C. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. UL Compliance:

1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."

1.7 COORDINATION

A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate sizes and locations of equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Packaged Energy Recovery Units: **Two** years.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS

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

1. Carnes Company.
2. Greenheck Fan Corporation.

3. Loren Cook Company.
4. Mitsubishi Electric & Electronics USA, Inc.
5. RenewAire LLC. (Basis of Design)
6. SEMCO LLC.

B. Housing: Manufacturer's standard construction for outdoor, rooftop application with corrosion-protection coating and exterior finish, hinged access doors or removable panels with neoprene gaskets for inspection and access to internal parts, minimum 1-inch-thick thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.

C. Heat Recovery Device: Fixed-plate heat exchanger with heat and humidity transfer.

D. Supply and Exhaust Fans: backward-inclined blower fan with spring hangers and insulated flexible duct connections.

1. Motor and Drive: Direct driven. Electronically Commutated.
2. 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."
3. 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.
4. Spring isolators on each fan having 1-inch static deflection.

E. Disposable Panel Filters:

1. Comply with NFPA 90A.
2. 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 lift out from access plenum.
3. Factory-fabricated, viscous-coated, flat-panel type.
4. Thickness: 2 inches.
5. MERV: 13, according to ASHRAE 52.2.
6. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
7. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

F. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls so only external connections are required during installation.

1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.

G. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Built-in cant and mounting flange. Coordinate with general trades contractor.
2. Overall Height: 12 inches.

H. Accessories:

1. Duct flanges.
2. Gravity backdraft dampers for exhaust and supply.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION.

A. Install fixed-plate heat exchangers so supply and exhaust airstreams flow in opposite directions.

1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger. Access doors and panels are specified in Section 233300 "Air Duct Accessories."

B. Install units with clearances for service and maintenance.

C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 CONNECTIONS

A. Comply with requirements for ductwork specified in Section 233113 "Metal Ducts."

B. Install electrical devices furnished with units but not factory mounted.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 237200

SECTION 237313.16 - INDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulated, double-wall-casing, indoor, semi-custom air-handling units that are factory assembled using multiple section components, including the following:

1. Casings.
2. Fans, drives, and motors.
3. Coils.
4. Air filtration.

1.3 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

    a. Include certified fan-performance curves with system operating conditions indicated.
    b. Include certified fan-sound power ratings.
    c. Include fan construction and accessories.
    d. Include motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each type and configuration of indoor, semi-custom air handling unit.

1. Include plans, elevations, sections, and mountingdetails.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of indoor, semi-custom air-handling units, as well as procedures and diagrams.
4. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittal: For vibration isolation and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and supports and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Source quality-control reports.

C. Startup service reports.

D. Field quality-control reports.

E. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.
3. Fan Belts: Oneset(s) for each air-handling unit fan that uses a belt.

1.7 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of indoor, semi-custom air-handling units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

F. Structural Performance: Casing panels shall be self-supporting and capable of withstanding positive/negative 8-inch wg (2000 Pa) of internal static pressure, without exceeding a midpoint deflection of 0.0042 inch/inch (0.0042 mm/mm) of panel span.

G. Casing Leakage Performance: ASHRAE 111, One percent or better at plus or minus 8 inch wg (2000 Pa).

2.2 CAPACITIES AND CHARACTERISTICS – See Schedules on Drawings

A. Supply Fan:

1. Type: Plenum Fan Array
2. Motor: ECM.

2.3 MANUFACTURERS

A. Available Manufacturers include:

1. Carrier Corporation– Basis of Design
2. Trane
3. Daikin

2.4 UNIT CASINGS

A. Frame: Modular and providing overall structural integrity without reliance on casing panels for structural support.

B. Base Rail:

1. Material: [Galvanized steel .
2. Height: 6 inches (150 mm).

C. Casing Joints: Hermetically sealed at each corner and around entire perimeter.

D. Double-Wall Construction:

1. Outside Casing Wall:

a. Material, Galvanized Steel: Minimum 14 gauge (2.0 mm)thick.
b. Factory Finish: Provide manufacturer's standard finish.

2. Inside Casing Wall:

a. Material, Galvanized Steel: minimum 18 gauge (1.3 mm) thick.
b. Antimicrobial Coating: Applied during the manufacturing process. EPA approved.

E. Floor Plate:

1. Material, Galvanized Steel: 14 gauge (2.0 mm)
2. Antimicrobial Coating: Applied during the manufacturing process. EPA approved.

F. Casing Insulation:

1. Materials: Injected polyurethane foam insulation.
2. Casing Panel R-Value: Minimum R-13.
3. Insulation Thickness: 2 inches (50 mm).
4. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

G. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

H. Static-Pressure Classifications:

1. For Unit Sections Upstream of Fans: Minus 4-inch wg (1000 Pa).
2. For Unit Sections Downstream and Including Fans: 4-inch wg (1000 Pa).

I. Panels, Doors, and Windows:

1. Panels:

a. Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow
c. Gasket: Neoprene, applied around entire perimeters of panel frames.
d. Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches (450 mm)wide by full height of unit casing up to a maximum height of 60 inches (1500 mm).

2. Doors:

a. Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
b. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
c. Gasket: Neoprene, applied around entire perimeters of panel frames.
d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches (450 mm) wide by full height of unit casing up to a maximum height of 60 inches (1500 mm).

3. Locations and Applications:

    a. Fan Section: Doors.
    b. Coil Section: Panels.
    c. Access Section: Panels.
    d. Access Sections Immediately Upstream and Downstream of Coil Sections: Doors
    e. Damper Section: Doors.
    f. Filter Section: Doors large enough to allow periodic removal and installation of filters.

J. Condensate Drain Pans:

1. Construction:
    a. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.

2. Drain Connection:

    a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
    b. Minimum Connection Size: NPS 1 (DN 25).

3. Slope: Minimum 0.125-in./ft. (10-mm/mm) slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
4. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
5. Width: Entire width of water producing device.
6. Depth: A minimum of 2 inches (50 mm) deep.
7. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.5 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Fans: Centrifugal, galvanized steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

    a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

    a. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with an L-50 rated life of 200,000 hours according to ABMA 9.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

    a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
5. Plenum Fan Arrays: Contained or Uncontained as defined in AHRI 430. Steel or aluminum frame with inlet cone and structural framing around each fan built into an array of multiple fans. Provide backdraft dampers at each fan to prevent short circuiting of flow if one fan is not operating.
6. Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
7. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch (25 mm).
8. Shaft Lubrication Lines: Extended to a location outside the casing.

C. Drive, Direct: Factory-mounted, direct drive.

D. Motors:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   a. .

2.6 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with AHRI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. For multizone units, provide air deflectors and air baffles to balance airflow across coils.
4. Coils shall not act as structural component of unit.

B. Heating Coils:

1. Hot-Water Coils:.

   a. Piping Connections: same end of coil.
   b. Tube Material: Copper.
   c. Fin Type: Plate.
   d. Fin Material: Aluminum.
   e. Fin Spacing: Maximum 10 fins per inch (mm).
   f. Headers:

      1) Cast iron with cleaning plugs and drain and air vent tappings extended to exterior of unit.
      2) Seamless copper tube with brazed joints, prime coated.
      3) Fabricated steel, with brazed joints, prime coated.
      4) Provide insulated cover to conceal exposed outside casings of headers.
   g. Coil Working-Pressure Ratings: 300 psig (2070 kPa), 200 deg F (93 deg C).

C. Cooling Coils:

1. Refrigerant Coil:

a. Tubes: Copper.
b. Fins:

1) Material: Aluminum.

c. Fin and Tube Joints: Mechanical bond.
d. Headers: Seamless-copper headers with brazed connections .
e. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

1) Working Pressure: Minimum 300 psig (2070 kPa).

2.7 AIR FILTRATION SECTION

A. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive.
4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

B. Side-Access Filter Mounting Frames:

1. Particulate Air Filter Frames: Match inner casing and outer casing material, and insulation thickness. Galvanized steel track.
   a. Sealing: Incorporate positive-sealing device to ensure seal between gasketed material on channels to seal top and bottom of filter cartridge frames to prevent bypass of unfiltered air.

2.8 DAMPERS

A. Dampers: Comply with requirements in Section 250000 "Building Automation Systems."

2.9 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B 09 (ASTM B209M).

2.10 SOURCE QUALITY CONTROL

A. AHRI 430 Certification: Test, rate, and label air-handling units and their components in accordance with AHRI 430.

B. AHRI 1060 Certification: Test, rate, and label air-handling units that include air-to-air energy recovery devices in accordance with AHRI 1060.

C. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label in accordance with AHRI 260 or AMCA 311.

D. Fan Aerodynamic Performance Rating: Factory test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency in accordance with AMCA 210.

E. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.

F. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

G. Water Coils: Factory tested to 300 psig (2070 kPa) according to AHRI 410 and ASHRAE 33.

H. Refrigerant Coils: Factory tested to minimum 450-psig (3105-kPa) internal pressure and to minimum 300-psig (2070-kPa) internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

I. Witnessed Casing Leakage Tests:

1. Pay for all expenses, for one representative designated by Owner, to travel to the factory to witness cabinet air-leakage testing on the specific assembled unit(s) prior to release for delivery to Project site.
2. If the unit(s) does not meet specified leakage requirements, perform factory modifications and retest. Do not release unit for shipment until tested leakage is measured to be within specified leakage and leakage testing report has been accepted by Owner's designated representative.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Equipment Mounting:

B. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC Piping and Equipment."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

E. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

F. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to air-handling unit, allow for service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using ASTM B88, Type M (ASTM B88M, Type C) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

F. Refrigerant Piping: Comply with applicable requirements. Install shutoff valve and union or flange at each supply and return connection.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that zone dampers fully open and close for each zone.
7. Verify that face-and-bypass dampers provide full face flow.
8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
9. Comb coil fins for parallel orientation.
10. Verify that proper thermal-overload protection is installed for electric coils.
11. Install new, clean filters.
12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.7 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan 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. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 DEMONSTRATION

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

END OF SECTION 237313.16

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

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.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

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 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: O**ne** set for each air-handling unit.
2. Gaskets: **One** set for each access door.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: **Five** years from date of Substantial Completion.
b. For Parts: **One** years from date of Substantial Completion.
c. For Labor: **One** year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers include:

1. Carrier Corporation– Basis of Design
2. Trane
3. Daikin

2.2 INDOOR UNITS (6 TONS (21 kW) OR MORE)

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm); leak tested to 300 psig (2070 kPa) underwater; with a two-position control valve.
5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Electrical Commutated Motors
    c. Three-phase, permanently lubricated, ball-bearing motors with built-in thermal-overload protection.
    d. Wiring Terminations: Connect motor to chassis wiring with plug connection.

7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: **2 inch (50 mm) thick, in fiberboard frames**
9. Condensate Drain Pans:

    a. Fabricated with **one or 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 **2 inches (50 mm)**] deep.

    b. Single-wall,**stainless**-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on **one or both ends** of pan.

        1) Minimum Connection Size: **NPS 1 (DN 25**.

    d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.3 OUTDOOR UNITS (6 TONS (21 kW) OR MORE)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant: **R-407C or R-410A**.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

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. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. 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.

E. Drain Hose: For condensate.

F. Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

2.5 CAPACITIES AND CHARACTERISTICS – See Schedules 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. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC Piping and Equipment."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

B. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect 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.

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 238126

SECTION 238129 - VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes complete VRF HVAC system(s) including, but not limited to, delegated design and the following components to make a complete operating system(s) according to requirements indicated:

1. Indoor, exposed, ceiling-suspended units.
2. Indoor, exposed, unit vent-style hybrid units.
3. Indoor, recessed, ceiling-mounted units.
4. Outdoor, air-source heat recovery units.
5. Heat recovery control units.
6. System controls.
7. System refrigerant and oil.
8. System condensate drain piping.
9. System refrigerant piping.
10. Metal hangers and supports.
11. Metal framing systems.
12. Fastener systems.
13. Pipe stands.
14. Miscellaneous support materials.
15. Piping and tubing insulation.
16. System control cable and raceways.

1.2 DEFINITIONS

A. Heat Recovery System Operation: System capable of operation with simultaneous heating and cooling zones that transfer heat between zones.

B. HRCU: Heat Recovery Control Unit. HRCUs are used in heat recovery VRF HVAC systems to manage and control refrigerant between indoor units to provide simultaneous heating and cooling zones. "Heat Recovery Control Unit" is the term used by ASHRAE for what different manufacturers term as branch circuit controller, branch selector box, changeover box, flow selector unit, mode change unit, and other such terms.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

D. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

E. Three-Pipe System Design: One high pressure refrigerant vapor line, one low pressure refrigerant vapor line, and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One liquid line and refrigerant vapor line connect HRCUs to associated indoor units.

F. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.

G. VRF: Variable refrigerant flow.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units and for HRCUs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
5. Include system operating sequence of operation in narrative form for each unique indoor- and outdoor-unit and HRCU control.
6. Include description of control software features.
7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
8. Include refrigerant type and data sheets showing compliance with requirements indicated.
9. For system design software.
10. Indicate location and type of service access.

B. Sustainable Design Submittals:

1. All components shall comply with ASHRAE 62.1-2016.
2. All components shall comply with ASHRAE 90.1-2010.

C. Shop Drawings: For VRF HVAC systems.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. 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.
4. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.

5. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: For fully and partially exposed indoor units with factory finishes viewable by occupants.

1. Include a Sample for each unique finish with unit identification, detailed description of application, and cross-referenced floor plans showing locations.

E. Delegated-Design Submittals:
1. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, sections, and 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. Suspended ceiling components.
2. Structural floors, roofs and associated members to which equipment, piping, ductwork, cables, and conduit will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Wall-mounted controllers located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
5. Items penetrating finished ceiling including the following:

a. Luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Service access panels.

B. Qualification Data:

1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.

a. Retain copies of Installer certificates on-site and make available on request.

2. For VRF HVAC system manufacturer.
3. For VRF HVAC system provider.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranties: For manufacturer's warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

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. Filters:

a. One set(s) for each unit with replaceable filters.
b. One set(s) for each unit type and unique size of washable filters.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Nationally recognized manufacturer of VRF HVAC systems and products.
2. Shipped VRF HVAC systems with similar requirements to those indicated for a continuous period of 10 years within time of bid.
3. VRF HVAC systems and products that have been successfully tested and in use on at least five completed projects.
4. Having complete published catalog literature, installation, and operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:

a. Product research and development.
b. Product and application engineering.
c. Product manufacturing, testing, and quality control.
d. Technical support for system installation training, startup, commissioning, and troubleshooting of installations.
e. Owner training.

B. Factory-Authorized Service Representative Qualifications:

1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
2. In-place facility located within 50 miles of Project.
3. Demonstrated past experience with products being installed for period within five consecutive years before time of bid.
4. Demonstrated past experience on five projects of similar complexity, scope, and value.

a. Each person assigned to Project shall have demonstrated past experience.

5. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
6. Service and maintenance staff assigned to support Project during warranty period.
7. Product parts inventory to support ongoing system operation for a period of not less than five years after Substantial Completion.
8. VRF HVAC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.

1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
2. Installer certification shall be valid and current for duration of Project.
3. Retain copies of Installer certificates on-site and make available on request.
4. Each person assigned to Project shall have demonstrated past experience.

a. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
b. Demonstrated past experience on five projects of similar complexity, scope, and value.

5. Installers shall have staffing resources of competent, trained, and experienced full-time employees that are assigned to execute work according to schedule.

D. Mockups: Build mockups to set quality standards for materials and execution.

1. Build mockups to show a finished installation for each of the following applications:

a. For each different indoor unit type with exposed surfaces viewable by occupants.

2. Mockups shall be operational.
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. Deliver and store products in a clean and dry place.

B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.

C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.

1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remover coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.

E. Replace installed products damaged during construction.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period. The warranty period begins from substantial completion.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Base Bid Warranty Period:

a. For Compressor: Seven years from date of Substantial Completion.
b. For Parts, Including Controls: Five years from date of Substantial Completion.
c. For Labor: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, **especially the ability to integrate Linear Expansion Valve kit or equal into VRF system and controls**, provide products by one of the following:

1. Daikin AC (Americas), Inc.
2. Johnson Controls, Inc.
3. Trane (Mitsubishi Electric & Electronics USA), Inc.
4. Carrier– Basis of Design

B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:

1. Indoor and outdoor units, including accessories.
2. Controls and software.
3. HRCUs.
4. Refrigerant isolation valves.
5. Specialty refrigerant pipe fittings.

2.2 SYSTEM DESCRIPTION

A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated. Unit Ventilators to have supplemental hot water heating coils as noted.

1. Two-pipe or three-pipe system design.
2. System(s) operation, heat recovery as indicated on Drawings.
3. Each system with one refrigerant circuit shared by all indoor units connected to system.

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. AHRI Compliance: System and equipment performance certified according to AHRI 1230.

D. ASHRAE Compliance:

1. ASHRAE 15: For safety code for mechanical refrigeration.
2. ASHRAE 62.1: For indoor air quality.
3. ASHRAE 135: For control network protocol with remote communication.
4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.

E. UL Compliance: Comply with UL 1995.

2.3 PERFORMANCE REQUIREMENTS

A. Service Access:

1. Provide and document service access requirements.
2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
4. If less than full and unrestricted access is provided, locate components within an 18-inch (450-mm) reach of the finished assembly.
5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
6. Comply with OSHA regulations.

B. System Design and Installation Requirements:

1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.

C. Isolation of Equipment: Provide isolation valves to isolate each HRCU, indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.

D. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
   1. Range acceptable to manufacturer.

E. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.

F. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.

G. Outdoor Conditions:

   1. Suitable for outdoor ambient conditions encountered.

      a. Design equipment and supports to withstand wind loads of governing code.
      b. Design equipment and supports to withstand snow and ice loads of governing code.

H. Sound Performance: Sound levels generated by operating HVAC equipment shall be within requirements indicated.

   1. Indoor: 45 dBA sound pressure.
   2. Outdoor: 67 dBA sound pressure.

I. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.

J. Capacities and Characteristics: As indicated on Drawings.

2.4 INDOOR, EXPOSED, CEILING-SUSPENDED UNITS

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

   1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
   2. Finish: factory-applied white finish
   3. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
   4. Mounting: Manufacturer-designed provisions for field installation.
   5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

   1. Coil Casing: Aluminum, galvanized, or stainless steel.
   2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.

3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:

1. Fan(s):

   a. Direct-drive arrangement.
   b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
   c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
   d. Wheels statically and dynamically balanced.

2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
2. Media:

   a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
   b. Washable: Manufacturer's standard filter with antimicrobial treatment.

G. Unit Accessories:
1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
2. Accessible filter box.

H. Unit Controls:

1. Enclosure: Metal, suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:

a. Unit inlet air temperature.
b. Coil entering refrigerant temperature.
c. Coil leaving refrigerant temperature.

4. Field-Customizable I/O Capability:

a. Analog Inputs: Four for use in customizable control strategies.
b. Digital Inputs: Four for use in customizable control strategies.
c. Digital Outputs: Four for use in customizable control strategies.

5. Features and Functions:

a. Self-diagnostics.
b. Time delay.
c. Auto-restart.
d. External static pressure control.
e. Auto operation mode.
f. Manual operation mode.
g. Filter service notification.
h. Power consumption display.
i. Drain assembly high water level safety shutdown and notification.
j. Run test switch.

6. Communication: Network communication with other indoor and outdoor units.
7. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
8. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

I. Unit Electrical:

1. Enclosure: Metal, suitable for indoor locations.
2. Field Connection: Single point connection to power unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways.

2.5 INDOOR, EXPOSED, UNIT VENT-STYLE HYBRID UNITS

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

B. Cabinet:

1. 16-gauge zinc-coated steel. All steel surfaces are cleaned, phosphatized, rinsed, and dried before application of final finish paint. The paint shall be applied by an electrostatic powder spray system. The paint shall result in an appliance-grade finish.

2. Floor-mounted units shall have an integral pipe tunnel for convenient crossover of piping or electrical wiring. The front surface shall consist of one removable panel for quick removal.
3. Cabinet end pockets shall be a minimum of 12 inches wide to facilitate piping and service. If less than 12 inches, unit manufacturer shall provide an extended cabinet or piping enclosure.
4. Additional end pocket of 2 feet shall be provided to house the VRF Linear Expansion Valve controller, and Linear Expansion Valve.
5. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
6. Mounting: Units shall have four adjustable leg levelers.
7. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
8. End panels shall be factory-installed on the unit.

C. Coils

1. Coils shall be selected in accordance with AHRI 440.
2. Hydronic Heating Coils:
    a. Hydronic coils shall be constructed with copper tubes and mechanically bonded aluminum corrugated plate fins. All coils shall have aluminum individual unshared fin surfaces, and shall be rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F.
    b. A threaded drain plug shall be furnished at the lowest point of the coil.
    c. A manual air vent shall be provided at the highest point of the coil.
3. DX Coil Assembly:
    a. Custom DX coil compatible with Linear Expansion Valve kit
    b. Coil Casing: Aluminum, galvanized, or stainless steel.
    c. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
    d. Coil Tubes: Copper, of diameter and thickness required by performance.
    e. Unit Internal Tubing: Copper tubing with brazed joints.
    f. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
    g. Field Piping Connections: Manufacturer's standard.
    h. Factory Charge: Dehydrated air or nitrogen.
    i. Testing: Factory pressure tested and verified to be without leaks.
    j. A DX low temperature limit sensor shall be provided.
    k. Refrigerant access ports shall be factory-supplied on the high and low side for easy refrigerant pressure or temperature testing.

D. Linear Expansion Valve Kit or equivalent for selected manufacturer

1. The Linear Expansion Valve Kit shall be a dedicated custom package to allow the integration of VRF system with custom direct expansion coils selected in accordance with factory specifications. The package comprises the following components:
    a. Controller
    b. NEMA 1 Rated Control Panel Enclosure
    c. Linear Expansion Valves
        1) Controller
        2) 2-ton nominal manifold
        3) 4-ton nominal manifold
    d. Thermistor (return air, liquid line, suction line, supply air)

e. Integrated power cable for termination at control panel in field

E. Drain Assembly:

1. The drain pan shall be constructed of smooth, corrosion resistant material. The bottom of the drain pan shall be sloped in two planes that pitch the condensate to the drain connection. Stainless steel drain pans shall be provided as an equal to polymer resin drain pans.
2. A drain outlet shall be provided on both ends of the pan with one outlet capped. The drain hand connection shall be easily field-reversed by relocating the cap to the opposite end.
3. Condensate Removal:
   a. Provide unit with field-installed condensate pump accessory.
4. Field Piping Connection: Non-ferrous material.
5. The condensate drain shall be internally or externally trapped per detail on drawings.

F. Fan and Motor Assembly:

1. Fan(s):
   a. Direct-drive arrangement.
   b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
   c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
   d. Wheels statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.
6. For quick maintenance, the fan board assembly shall be a single, rigid assembly including fans, fan housing, bearing, and fan shaft.
7. Provide quick connects for the fan motor for easy maintenance and removal.

G. Fresh Air and Room Air Dampers

1. The unit shall be equipped with a dual-blade mixing damper with a compressible seal to ensure proper modulation and mixing of the room air and fresh air.
2. The damper shall be capable of varying the proportion of mixed air from 100 percent room air to 100 percent fresh air.
3. Provide an ultra-low leak damper seal made of closed cell EPDM material. Leakage shall be less than 1 percent against 0.5 inches of external static pressure.
4. Damper shall contain a continuous divider placed between the damper blades to separate the fresh air and room air compartments to prevent blow-through.

H. Filter Assembly:

1. Filters: Each unit shall be equipped with a single 1-inch thick, throwaway filter accessible without the removal of the unit front panel.

I. Grille Assembly:

1. The unit discharge grille shall be of a double deflection type to throw air in two directions.
2. To prevent entry of small objects into the fan, provide a discharge grille screen for fans located in the line of sight.

J. Unit Accessories:

1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
2. Condensate Pump: Integral reservoir and control with electrical power connection through unit power.

K. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Field-Customizable I/O Capability:

   a. Analog Inputs: Four for use in customizable control strategies.
   b. Digital Inputs: Four for use in customizable control strategies.
   c. Digital Outputs: Four for use in customizable control strategies.

4. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification, drain assembly high water level safety shutdown and notification, run test switch.
5. Communication: Network communication with other indoor units and outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

L. Unit Electrical:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

2.6 INDOOR, RECESSED, CEILING-MOUNTED AND FLOOR MOUNTED UNITS

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.

2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material.

E. Hydronic Heating Coils:

1. Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

F. Fan and Motor Assembly:

1. Fan(s):

    a. Direct-drive arrangement.
    b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    d. Wheels statically and dynamically balanced.

2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

G. Filter Assembly:

1. Access: Bottom, to accommodate filter replacement without the need for tools.
2. Media:

    a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
    b. Washable: Manufacturer's standard filter with antimicrobial treatment.

H. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.

1. Discharge Pattern: four-way throw.

    a. Discharge Pattern Adjustment: Field-adjustable limits for up and down range of motion.
    b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns.

2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.
3. Additional Branch Supply Duct Connection: Sheet metal knockout for optional connection to one additional supply branch duct.

I. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.

J. Unit Accessories:
1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

K. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors: Unit inlet air temperature, Coil entering refrigerant temperature, Coil leaving refrigerant temperature.
4. Field-Customizable I/O Capability:

    a. Analog Inputs: Four for use in customizable control strategies.
    b. Digital Inputs: Four for use in customizable control strategies.
    c. Digital Outputs: Four for use in customizable control strategies.

5. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification, power consumption display, drain assembly high water level safety shutdown and notification, run test switch.
6. Communication: Network communication with other indoor units and outdoor unit(s).
7. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
8. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

L. Unit Electrical:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.

4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

2.7 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS AND HEAT PUMPS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3. All units installed shall be from the same product development generation.

B. Cabinet:

1. Galvanized steel and coated with a corrosion-resistant finish.

2. Mounting: Manufacturer-designed provisions for field installation.
3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Compressor and Motor Assembly:

1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
2. Protection: Integral protection against the following:

    a. High refrigerant pressure.
    b. Low oil level.
    c. High oil temperature.
    d. Thermal and overload.
    e. Voltage fluctuations.
    f. Phase failure and phase reversal.
    g. Short cycling.

3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
4. Vibration Control: Integral isolation to dampen vibration transmission.
5. Oil management system to ensure safe and proper lubrication over entire operating range.
6. Crankcase heaters with integral control to maintain safe operating temperature.
7. Fusible plug.

D. Condenser Coil Assembly:

1. Plate Fin Coils:

    a. Casing: Aluminum, galvanized, or stainless steel.

b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
c. Tubes: Copper, of diameter and thickness required by performance.

2. Aluminum Microchannel Coils:

a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
b. Single- or multiple-pass arrangement.
c. Construct fins, tubes, and header manifolds of aluminum alloy.

3. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

E. Condenser Fan and Motor Assembly:

1. Fan(s): Propeller type.

a. Direct-drive arrangement.
b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
c. Statically and dynamically balanced.

2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
6. Vibration Control: Integral isolation to dampen vibration transmission.

F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

G. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:

a. Refrigerant suction temperature.
b. Refrigerant discharge temperature.
c. Outdoor air temperature.
d. Refrigerant high pressure.
e. Refrigerant low pressure.
f. Oil level.

4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch equalize run time between multiple same components.
5. Communication: Network communication with indoor units and other outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

H. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

I. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.8 HEAT RECOVERY CONTROL UNITS (HRCUs)

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.

B. Cabinet:

1. Galvanized-steel construction.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

D. Refrigeration Assemblies and Specialties:

1. Specially designed by manufacturer for type of VRF HVAC system being installed, either two or three pipe.
2. Each refrigerant branch circuit shall have refrigerant control valve(s) to control refrigerant flow.

3. Each system piping connection upstream of heat recovery unit shall be fitted with an isolation valve to allow for service to any heat recovery control unit in the system without interrupting operation of the system.
4. Each branch circuit connection shall be fitted with an isolation valve and capped service port to allow for service to any individual branch circuit without interrupting operation of the system.

    a. If not available as an integral part of the heat recovery control unit, isolation valves shall be field installed adjacent to the unit pipe connection.

E. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Features and Functions: Self-diagnostics, fuse protection.
4. Communication: Network communication with indoor units and outdoor unit(s).
5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

F. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

G. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.9 SYSTEM CONTROLS

A. General Requirements:

1. Network: Indoor units, HRCUs, and outdoor units shall include integral controls and connect through a TIA-485A or manufacturer-selected control network.
2. Network Communication Protocol: open control communication between interconnected units.
3. Integration with Building Automation System: ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including the following:

a. Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher.
b. Integration devices shall be connected to local uninterruptible power supply unit(s) to provide at least 5 minutes of battery backup operation after a power loss.
c. Integration shall include monitoring, scheduling, and change of value notifications.

4. Operator Interface:

a. Operators shall interface with system and unit controls through the following:

1) Operator interfaces integral to controllers.
2) Web interface through web browser software.

b. Users shall be capable of interface with controllers for indoor units control to extent privileges are enabled. Control features available to users shall include the following:

1) On/off control.
2) Temperature set-point adjustment.

B. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.

a. Include multiple interconnected controllers as required.

2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.

a. Sets schedule for daily, weekly, and annual events.
b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.

4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.
9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel and web accessible through standard web browser software.

C. Wired Controllers for Indoor Units:

1. Single controller capable of controlling multiple indoor units as group.
2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
3. Temperature Units: Fahrenheit and Celsius.
4. On/Off: Turns indoor unit on or off.
5. Hold: Hold operation settings until hold is released.
6. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
7. Temperature Display: 1-degree increments.
8. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments between.
9. Relative Humidity Display: 1 percent increments.
10. Relative Humidity Set-Point: Adjustable in 1 percent increments between.
11. Fan Speed Setting: Select between available options furnished with the unit.
12. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
13. Seven-day programmable operating schedule with up to five events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
14. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
15. Occupancy detection.
16. Service Notification Display: "Filter".
17. Service Run Tests: Limit use by service personnel to troubleshoot operation.
18. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
19. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
20. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
21. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

D. Wireless Controllers for Indoor Units:

1. Wireless Communication:

    a. Controller communicates to remote-mounted receiver that is wired to indoor unit(s).

        1) Include receivers with wireless controllers as required to complete installation.
        2) Low-voltage power required for receivers shall be powered through non-polar connections to indoor unit.

    b. One wireless controller shall be capable of communicating with one or multiple receivers to control one or multiple indoor units as a group.

2. Controller Battery Life: Three years.
3. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
4. Temperature Units: Fahrenheit and Celsius.
5. On/Off: Turns indoor unit on or off.
6. Hold: Hold operation settings until hold is released.
7. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
8. Temperature Display: 1-degree increments.

9. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments between.
10. Relative Humidity Display: 1 percent increments.
11. Relative Humidity Set-Point: Adjustable in 1 percent increments between.
12. Fan Speed Setting: Select between available options furnished with the unit.
13. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
14. Seven-day programmable operating schedule with up to five events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
15. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
16. Occupancy detection.
17. Service Notification Display: "Filter".
18. Service Run Tests: Limit use by service personnel to troubleshoot operation.
19. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
20. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
21. Setting stored in non-volatile memory to ensure that settings are not lost if power is lost. Battery for date and time only.

2.10 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. ASHRAE 34, Class A1 refrigerant classification.
3. R-410a.

B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.11 SYSTEM CONDENSATE DRAIN PIPING

A. If more than one material is listed, material selection is Contractor's option.

B. Copper Tubing:

1. Drawn-Temper Tubing: According to ASTM B88, Type L (ASTM B88M, Type B).
2. Wrought-Copper Fittings: ASME B16.22.
3. Wrought-Copper Unions: ASME B16.22.
4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.

C. Comply with requirements in Section 232113 "Hydronic Piping" for system piping requirements.

2.12 SYSTEM REFRIGERANT PIPING

A. Refrigerant Piping:

1. Copper Tube: ASTM B280, Type ACR.
2. Wrought-Copper Fittings: ASME B16.22.
3. Brazing Filler Metals: AWS A5.8/A5.8M.

B. Refrigerant Tubing Kits:

1. Furnished by VRF HVAC system manufacturer.
2. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
3. Standard one-piece length for connecting to indoor units.
4. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
5. Factory Charge: Dehydrated air or nitrogen.

C. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.

D. Refrigerant Isolation Ball Valves:

1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
3. Valve Connections: Flare or sweat depending on size.

2.13 METAL HANGERS AND SUPPORTS

A. Copper Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized or copper-coated steel.

B. Plastic Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, galvanized-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.

2.14 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated, pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel for use indoors and of stainless steel for use outdoors.
6. Metallic Coating for Use Indoors: Electroplated zinc, hot-dip galvanized, or mill galvanized.
7. Plastic Coating for Use Outdoors: PVC, polyurethane, epoxy, or polyester.

2.15 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Indoor Applications: Zinc-coated or stainless steel.
2. Outdoor Applications: Stainless steel.

2.16 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.17 MISCELLANEOUS SUPPORT MATERIALS

A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

B. Threaded Rods: Continuously threaded. Zinc-plated steel or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar material as rods.

2.18 PIPING AND TUBING INSULATION

A. Condensate Drain Piping and Tubing Insulation and Jacket Requirements:

1. Flexible Elastomeric Insulation:

a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
b. Indoors: 1/2 inch (13 mm) thick.
c. Outdoors: None.

B. Refrigerant Tubing Insulation and Jacket Requirements:

1. Flexible Elastomeric Insulation:

a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
b. Indoors: 1 inch (25 mm) thick.
c. Outdoors: 1 inch (25 mm) thick.

2. Field-Applied Jacket:

a. Concealed: None required.
b. Indoors, Exposed to View: PVC, 20 mils (0.5 mm) thick.
c. Outdoors, Exposed to View: Aluminum, smooth, 0.020 inch (0.51 mm) thick.

C. Flexible Elastomeric Insulation Adhesive: Comply with MIL-A-24179A, Type II, Class I.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

E. Metal 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 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.

2.19 SYSTEM CONTROL CABLE

A. Cable Rating: Listed and labeled for application according to NFPA 70.

1. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

    a. Flame Travel Distance: 60 inches (1520 mm) or less.
    b. Peak Optical Smoke Density: 0.5 or less.
    c. Average Optical Smoke Density: 0.15 or less.

2. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
3. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

B. Low-Voltage Control Cabling:

1. Paired Cable: NFPA 70, Type CMG.

    a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
    b. PVC insulation.
    c. Braided or foil shielded.
    d. PVC jacket.
    e. Flame Resistance: Comply with UL 1685.
2. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

    a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
    b. PVC insulation.
    c. Braided or foil shielded.
    d. PVC jacket.
    e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
    f. Flame Resistance: Comply with NFPA 262.

C. TIA-485A Network Cabling:

1. Standard Cable: NFPA 70, Type CMG.

    a. Paired, one pair, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
    b. PVC insulation.
    c. Unshielded.
    d. PVC jacket.
    e. Flame Resistance: Comply with UL 1685.
2. Plenum-Rated Cable: NFPA 70, Type CMP.

    a. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
    b. Fluorinated ethylene propylene insulation.
    c. Unshielded.
    d. Fluorinated ethylene propylene jacket.
    e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.

f. Flame Resistance: NFPA 262.

D. Ethernet Network Cabling: TIA-568-C.2 Category 6 or 6a Insert category cable with RJ-45 connectors.

1. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of category cable indicated.
2. Conductors: 100-ohm, 23 AWG solid copper.
3. Shielding: Shielded twisted pairs (FTP).
4. Cable Rating: By application.
5. Jacket: Thermoplastic.

E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for control wiring and cable raceways.

2.20 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

2.21 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect factory-assembled equipment.

B. Equipment will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports for historical record. Submit reports only if requested.

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 products before installation. Reject products that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.

D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.

E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.

F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.

G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION, GENERAL

A. Clearance:

1. Maintain manufacturer's recommended clearances for service and maintenance.
2. Maintain clearances required by governing code.

B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.

3.3 INSTALLATION OF INDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch (10 mm).

C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.

D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.

E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

G. Provide lateral bracing if needed to limit movement of suspended units to not more than [**0.25 inch.**

H. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.

I. Attachment: Install hardware for proper attachment to supported equipment.

3.4 INSTALLATION OF OUTDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Install outdoor units on support structures indicated on Drawings.

C. Roof-Mounted Installations: Anchor units to supports with removable, stainless-steel fasteners.

3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping and tubing to permit valve servicing.

F. Install piping and tubing at indicated slopes.

G. Install piping and tubing free of sags.

H. Install fittings for changes in direction and branch connections.

I. Install piping and tubing to allow application of insulation.

J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.

K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

A. General Requirements for Drain Piping and Tubing:

1. Install a union in piping at each threaded unit connection.
2. Install an adjustable stainless-steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:

    a. Details indicated on Drawings.
    b. Manufacturer's requirements.
    c. Governing codes.
    d. In the absence of requirements, comply with requirements of ASHRAE handbooks.

4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Gravity Drains:

1. Slope piping from unit connection toward drain termination at a constant slope of not less than one percent.

3.7 INSTALLATION OF REFRIGERANT PIPING

A. Refrigerant Tubing Kits:

1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet (1.5 m). Minimum rod size, 1/4 inch (6.4 mm).
3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.

B. Install refrigerant piping according to ASHRAE 15 and governing codes.

C. Select system components with pressure rating equal to or greater than system operating pressure.

D. Install piping as short and direct as possible, with a minimum number of joints and fittings.

E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels if valves or equipment requiring maintenance is concealed behind finished surfaces.

F. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.

G. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:

1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps to entrain oil in vertical runs.
4. Liquid lines may be installed level.

H. When brazing, remove or protect components that could be damaged by heat.

I. When brazing, purge refrigerant piping continually with dry nitrogen.

J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.

K. Joint Construction:

1. Ream ends of tubes and remove burrs.
2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

3.8 INSTALLATION OF METAL HANGERS AND SUPPORTS

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 Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

C. Comply with MFMA-103 for metal framing system selections and applications that are not specified.

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-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

F. 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 and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units. Install piping and insulation to avoid abrasion from sharp edges during operational movement.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel.

1. 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. Piping and Tubing Insulation:

1. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
2. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.

M. Horizontal-Piping Hangers and Supports: 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 (DN 15 to DN 750).
2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
4. Multiple horizontal pipes located indoors may use metal framing systems with split clamp attachment for each pipe in lieu if individual clevis hangers.
5. Pipe stands for horizontal pipes located outdoors.
6. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
7. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

N. Horizontal Piping Hanger Spacing and Rod Size: Install hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:

1. Sizes through NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).

7. NPS 3 (DN 80) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

O. Vertical-Piping Clamps: Install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): If longer ends are required for riser clamps.

P. Support vertical runs at roof, at each floor, and at midpoint intervals between floors, not to exceed 10 feet (3 m).

Q. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified.

R. Use hangers, supports, and attachments with galvanized coatings unless otherwise indicated.

S. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

T. Trim excess length of continuous-thread hanger and support rods to 1 inch (25 mm).

U. Hanger-Rod Attachments: Install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

V. Building Attachments: 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 (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).

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.

3.9 INSTALLATION OF PIPING AND TUBING INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Installation to maintain a continuous vapor barrier.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are unavailable, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Where PVC jackets are indicated, install with 1-inch (25-mm) 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.

E. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.10 ELECTRICAL INSTALLATION

A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.

B. Coordinate electrical requirements of provided equipment with electrical contractor – during the submittal phase. .

C. Install nameplate or acrylic label with self-adhesive back for each electrical connection indicating electrical equipment designation and circuit number feeding connection.
   1. Locate nameplate or label where easily visible.

D. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or revised in this Section.

3.11 SOFTWARE

A. Cybersecurity:

   1. Software:

      a. Coordinate security requirements with IT department.
      b. Ensure that latest stable software release is installed and properly operating.
      c. Disable or change default passwords to password using a combination of uppercase and lower letters, numbers, and symbols at least eight characters in length. Record passwords and turn over to party responsible for system operation and administration.

   2. Hardware:

      a. Coordinate location and access requirements with IT department.
      b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
      c. Disable dual network connections.

3.12 INSTALLATION OF SYSTEM CONTROL CABLE

A. Comply with NECA 1.

B. Installation Method:

   1. Install cables in raceways except as follows:

      a. Within equipment and associated control enclosures.

   2. Conceal raceway and cables except in unfinished spaces.

C. General Requirements for Cabling:

   1. Comply with TIA-568-C Series of standards.
   2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
   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 and shall be continuous from terminal to terminal. Do not splice cable.
   5. Cables serving a common system may be grouped in a common raceway. Install control cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.

6. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles or access panels.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals.
15. Do not bend cables in a radius less than 10 times the cable OD.
16. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
17. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

D. Balanced Twisted-Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted-pair cables more than 1/2 inch (13 mm) at the point of termination to maintain cable geometry.

E. Open-Cable Installation:

1. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 30 inches (760 mm) apart.
2. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources: Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded cable from potential EMI sources including electrical power wiring and equipment.

3.13 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.14 GROUNDING INSTALLATION

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

3.15 IDENTIFICATION

A. Identify system equipment, piping, tubing, and valves. Comply with requirements for identification specified in Section 230553 "Identification for HVAC Piping and Equipment."

B. Identify system electrical and controls components, wiring, cabling, and terminals.

1. Identify each control cable on each end and at each terminal with a number-coded identification tag. Each cable shall have a unique tag.

3.16 FIELD QUALITY CONTROL

A. The contractor shall keep a copy of the manufacturer’s approved VRF piping diagram at the jobsite at all times.

B. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.

1. Field service shall be performed by a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.

2. Manufacturer shall provide on-site visits during the course of construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.

   a. First Visit: Kick-off meeting.
   b. Second Visit: At approximately 25 percent completion of system(s).
   c. Third Visit: At approximately 50 percent completion of system(s).
   d. Fourth Visit: At approximately 75 percent completion of system(s).
   e. Fifth Visit: Final inspection before system startup.

3. Kick-off Meeting:

   a. Meeting shall include system Installer and other related trades with sole purpose of reviewing VRF HVAC system installation requirements and close coordination required to make a successful installation.
   b. Meeting shall be held at Project site and scheduled at a mutually agreed to time that occurs before the start of any part of system installation.
   c. Meeting shall cover the following as a minimum requirement:

      1) Review of latest issue of Contract Documents, Drawings, and Specifications, relevant to VRF HVAC systems.
      2) Manufacturer's installation requirements and diagrams specific to systems being installed.
      3) Review of all relevant VRF HVAC system submittals, including delegated-design submittals.
      4) Required field activities related installation of VRF HVAC system.
      5) Project team communication protocol, contact information, and exchange of responsibilities for each party involved, including manufacturer, supplier, system Installer, and other related trades.

4. Site Visits: Activities for each site visit shall include the following:

    a. Meet with VRF HVAC system Installer to discuss field activities, issues, and suggested methods to result in a successful installation.
    b. Offer technical support to Installer and related trades as related to VRF system(s) being installed.
    c. Review progress of VRF HVAC system(s) installation for strict compliance with manufacturer's requirements and design.
    d. Advise and if necessary assist Installer with updating related refrigerant calculations and system documentation.
    e. Issue a report for each visit, documenting the visit.

        1) Report to include name and contact information of individual making the visit.
        2) Date(s) and time frames while on-site.
        3) Names and contact information of people meeting with while on-site.
        4) Clearly identify and list each separate issue that requires resolution. For each issue, provide a unique identification number, relevant importance, specific location or equipment identification, description of issue, recommended corrective action, and follow-up requirements needed. Include a digital photo for clarification if deemed to be beneficial.

5. Final Inspection before Startup:

    a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according manufacturer's requirements and ready for final inspection.
    b. Installer shall confirm that all changes to the VRF piping system have been noted by the manufacturer’s representatives. Manufacturer’s representatives shall update the VRF design program to reflect the “as-built” piping condition. As-built VRF design program files and proper refrigerant charge shall be calculated and communicated to the startup technician.
    c. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
    d. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
    e. Inspection reports for indoor units shall include, but not be limited to, the following:

        1) Unit designation on Drawings.
        2) Manufacturer model number.
        3) Serial number.
        4) Network address, if applicable.
        5) Each equipment setting.
        6) Mounting, supports, and restraints properly installed.
        7) Proper service clearance provided.
        8) Wiring and power connections correct.
        9) Line-voltage reading(s) within acceptable range.
        10) Wiring and controls connections correct.
        11) Low-voltage reading(s) within an acceptable range.
        12) Controller type and model controlling unit.
        13) Controller location.

14) Temperature settings and readings within an acceptable range.
15) Humidity settings and readings within an acceptable range.
16) Condensate removal acceptable.
17) Fan settings and readings within an acceptable range.
18) Unit airflow direction within an acceptable range.
19) If applicable, fan external static pressure setting.
20) Filter type and condition acceptable.
21) Noise level within an acceptable range.
22) Refrigerant piping properly connected and insulated.
23) Condensate drain piping properly connected and insulated.
24) If applicable, ductwork properly connected.
25) If applicable, external interlocks properly connected.
26) Remarks.

f. Inspection reports for outdoor units shall include, but not be limited to, the following:

1) Unit designation on Drawings.
2) Manufacturer model number.
3) Serial number.
4) Network address, if applicable.
5) Each equipment setting.
6) Mounting, supports, and restraints properly installed.
7) Proper service clearance provided.
8) Wiring and power connections correct.
9) Line-voltage reading(s) within acceptable range.
10) Wiring and controls connections correct.
11) Low-voltage reading(s) within an acceptable range.
12) Condensate removal acceptable.
13) Noise level within an acceptable range.
14) Refrigerant piping properly connected and insulated.
15) Condensate drain piping properly connected and insulated.
16) Remarks.

g. Installer shall provide manufacturer with the requested documentation and technical support during inspection.
h. Installer shall correct observed deficiencies found by the inspection.
i. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
j. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved and systems are deemed ready for startup.
k. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are ready for startup.

C. Perform the following tests and inspections with the assistance of manufacturer's service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Refrigerant Tubing Positive Pressure Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure prescribed by manufacturer using dry nitrogen.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours or manufacturer’s requirement, whichever is greater. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Prepare test report to record the following information for each test:

    a. Name of person starting test, company name, phone number, and e-mail address.
    b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    c. Detailed description of extent of tubing tested.
    d. Date and time at start of test.
    e. Test pressure at start of test.
    f. Outdoor temperature at start of test.
    g. Name of person ending test, company name, phone number, and e-mail address.
    h. Date and time at end of test.
    i. Test pressure at end of test.
    j. Outdoor temperature at end of test.
    k. Remarks:

5. Submit test reports for Project record.

E. Refrigerant Tubing Evacuation Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
4. Prepare test report to record the following information for each test:

    a. Name of person starting test, company name, phone number, and e-mail address.
    b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    c. Detailed description of extent of tubing tested.
    d. Date and time at start of test.
    e. Test pressure at start of test.
    f. Outdoor temperature at start of test.
    g. Name of person ending test, company name, phone number, and e-mail address.
    h. Date and time at end of test.
    i. Test pressure at end of test.
    j. Outdoor temperature at end of test.
    k. Remarks:

5. Submit test reports for Project record.
6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

F. System Refrigerant Charge:

1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
3. System refrigerant charging shall be witnessed by system manufacturer's representative.
4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

G. Products will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

I. Manufacturer’s local sales representative shall be onsite with manufacturer’s service representative for the entire duration of all five scheduled site visits. In addition, manufacturer’s local sales representative shall be onsite for one intermediate 2 hour site visit in between each site visit of the manufacturer’s service representative. Manufacturer’s local sales representative site visits shall entail activities described in subparagraph 3.16.A.4. During the site visits, sales representative shall verify that VRF piping and equipment are installed per the design. Any deviations from the design shall be noted by sales representative and contractor shall be directed by sales representative to change the installation to match the design. If a change to the design is necessary, the contractor shall provide detailed explanation and description of changes required. The contractor shall update the VRF piping diagram with any field changes such as re-routing, shortening, lengthening or changing diameter of a pipe segment, adding or eliminating elbows and or fittings, resizing adding or eliminating indoor units, changing the mounting height, or moving the location of a device or fitting during installation. Those changes shall be communicated to the VRF manufacturer’s sales and service representatives. The manufacturer’s representatives upon receipt of those changes shall enter them into the manufacturer’s VRF design program. If the VRF design program indicates that the deviations do not meet the program’s criteria for proper system piping the manufacturer’s representatives shall inform the contractor of any associated problems and resolution for those problems. The contractor shall correct piping to eliminate piping problems.

3.17 STARTUP SERVICE

A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.

1. Service representative shall be a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
2. Complete startup service of each separate system.
3. Complete system startup service according to manufacturer's written instructions.

B. Startup checks shall include, but not be limited to, the following:

1. Check control communications of equipment and each operating component in system(s).
2. Check each indoor unit's response to demand for cooling and heating.
3. Check each indoor unit's response to changes in airflow settings.
4. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
5. Check sound levels of each indoor and outdoor unit.

C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.

1. Installer shall correct deficiencies found during startup service for reverification.

D. System Operation Report:

1. After completion of startup service, manufacturer shall issue a report for each separate system to owner, architect, and commissioning agent.
2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
3. Manufacturer shall electronically record not less than four hours of continuous operation of each system and submit with report for historical reference.

a. All available system operating parameters shall be included in the information submitted.

E. Witness:

1. Invite Architect, Engineer, Owner, and Commissioning Agent to witness startup service procedures.
2. Provide written notice not less than 14 business days before start of startup service.

3.18 ADJUSTING

A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.

C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.

D. Occupancy Adjustments: Within 12 months from date of Substantial Completion, manufacturer’s service representative shall provide on-site assistance in adjusting system to suit actual occupied conditions. Provide at least four visits to Project (including other-than-normal occupancy hours) for this purpose. Site visits shall be at least 2 hours in duration. Site visits shall occur during heating and cooling seasons.

3.19 PROTECTION

A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.

B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.

C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.

D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

3.20 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of system Installer who are manufacturer's authorized service representative. Include four service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. One visit shall coincide with commissioning authority’s 10 month walk-through. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.21 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

3.22 DEMONSTRATION

A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

B. Instructor:

1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.
2. Instructor's credentials shall be submitted for review by Architect before scheduling training.
3. Instructor(s) shall have not less than three years of training experience with VRF HVAC system manufacturer and past training experience on at least three projects of comparable size and complexity.

C. Schedule and Duration:

1. Schedule training with Owner at least 20 business days before first training session.
2. Training shall occur before Owner occupancy.
3. Training shall be held at mutually agreed date and time during normal business hours.

4. Each training day shall not exceed eight hours of training. Daily training schedule shall allow time for one-hour lunch period and 15-minute break after every two hours of training.
5. Perform not less than eight total hours of training.

D. Location: Owner shall provide a suitable on-site location to host classroom training.

E. Training Attendees: Assume four people.

F. Training Attendance: For record purposes, document training attendees at the start of each new training session. Record attendee's name, signature, phone number, and e-mail address.

G. Training Format: Individual training modules shall include classroom training followed by hands-on field demonstration and training.

H. Training Materials: Provide training materials in electronic format to each attendee.

1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.

I. Acceptance: Obtain Architect, Commissioning Agent, or Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 238129

SECTION 238216.11 - HYDRONIC AIR COILS

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. Hydronic air coils.

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 air coil.
2. Include rated capacities, operating characteristics, and pressure drops for each air coil.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, sections, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE 62.1 Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5, "Systems and Equipment," and Section 7, "Construction and Startup."

B. Performance Ratings: Tested and rated in accordance with AHRI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 200 psig (1380 kPa)/300 deg F (149 deg)

D. Select cooling coils for no moisture carryover at design conditions. Provide moisture eliminators on discharge face of cooling coil if necessary to eliminate moisture carryover.

E. Hot-Water Coil Capacities and Characteristics: See schedules on drawings

2.2 HYDRONIC AIR COILS

A. Source Limitations: Obtain hydronic coils from single source from single manufacturer.

B. Description: Coils constructed of staggered tubes mechanically expanded into continuous collars that are die-formed into the coil fins; self-venting; counterflow design of air to fluid.

C. Tubes:

1. Material: Copper.
2. Nominal Diameter: selected to provide performance indicated.
3. Nominal Wall Thickness: As required by performance,
4. Return Bends: 180-degree bends; material, and nominal diameter to match tubes.
5. Fluid Velocity at Design Flow Rate:

    a. Maximum: 6 fps (1.8 m/s).
    b. Minimum: 3 fps (0.9 ms).

6. Features: Cleanable.

D. Fins:

1. Type: Plate.
2. Materials:

    a. Aluminum: 0.0060 inch (0.15 mm) thick.
    b. Copper: [0.0060 inch (0.15 mm) thick.
    c. 90/10 Cupronickel: 0.0060 inch (0.15 mm).

3. Spacing: Maximum 12 fins per inch (2.1 mm).
4. Collars: Full collars for accurate fin spacing and maximum tube contact while leaving no surface of tube exposed.

E. Headers:

1. Material: Copper, removable for cleaning and inspection of tubes.
2. Tube-to-Header Connections: Tube-to-header holes to intrude inward, so landed surface area is 3 times the core tube thickness, to provide enhanced-header-to-tube joint integrity. Evenly extend tubes within the ID of the header no more than 0.12 inch (3 mm).
3. Header Top and Bottom Caps: End caps to be die-formed and installed on the ID of header, such that the landed surface area is 3 times the header wall thickness.
4. Drains: Include low point of supply header with a NPS 1/2 (DN 13) drain connection.
5. Vents: Include high point of supply header with a NPS 1/2 (DN 13) vent connection.
6. Supply and Return Connections: Copper pipe; same or opposite ends of coil.
7. Protect opening of supply, return, vent, and drain connections with a threaded cap to prevent entry of dirt into coil.
8. Fluid Velocity at Design Flow Rate: Maximum of 6 fps (1.8 m/s).

F. Casings and Tube Sheets:

1. Depth: Extend coil casing and tube sheets a minimum of 1/2 inch (13 mm) beyond face of fins on both entering and leaving sides.
2. Materials:

a. Stainless steel, No. 2D finish, ASTM A240/A240M.
b. Galvanized steel, ASTM A653/A653M, G90 (Z275) coating.
c. Copper, ASTM B152/B152M.

G. Hardware: Use hex-head bolts, nuts, and washers constructed of Type 304 or Type 316 stainless steel.

H. Nameplate: Aluminum or stainless steel nameplate with brass or stainless steel chain for each coil, with the following data engraved or embossed:

1. Manufacturer name, address, telephone number, and website address.
2. Manufacturer model number.
3. Serial number.
4. Manufacturing date.
5. Coil identification (indicated on Drawings).
6. Coil fin length.
7. Coil fin height.
8. Coil weight with fluid/without fluid.
9. Coil casing material and thickness.
10. Coil fin material and thickness.
11. Coil tube material and thickness.
12. Coil header material and thickness.

2.3 MATERIALS

A. Aluminum: ASTM B209 (ASTM B209M).

B. Copper Tube: ASTM B75/ASTM 75M annealed temper or ASTM B280 drawn temper.

C. Copper Sheet: ASTM B152.

D. 90/10 Cupronickel Alloy: ASTM B122/ASTM B122M.

E. Steel:

1. Pipe Connections: ASTM A53/A53M.

2.4 SOURCE QUALITY CONTROL

A. Hydronic Coils: Factory tested with air while coil is completely submerged underwater to design pressure indicated, but not less than 300-psig (2070-kPa) internal pressure.

B. Coils to display a tag with inspector's identification as proof of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed in accordance with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Straighten bent fins on air coils.

D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 250000 "Building Automation Systems," and other piping specialties are specified in Section 232113 "Hydronic Piping."

END OF SECTION 238216.11

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Cabinet unit heaters.

B. Propeller unit heaters.

C. Wall and ceiling unit heaters.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. DDC: Direct digital control.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of piping valves and specialties.
7. Indicate location and arrangement of integral controls.
8. Wiring Diagrams: Power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

E. Samples for Verification: Finish colors for each type of cabinet unit heater indicated with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other 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. Suspended ceiling components.
2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

B. Seismic Qualification Certificates: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Include detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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. Cabinet Unit-Heater Filters: Furnish one spare filter(s) for each filter installed.

1.8 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

C. Seismic Performance: Cabinet unit heaters shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7].

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

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

1. Daikin Applied
2. Berko, Marley International
3. Markel Products
4. Trane
5. Zhender Rittling

B. Description

1. Factory-assembled and -tested unit complying with AHRI 440.
2. 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.
3. Comply with UL 2021.

C. Coil section insulation

1. Insulation Materials: Comply with NFPA 90A or NFPA 90B. Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density
   a. Thickness 1/2 inch (13 mm).
   b. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75 deg F (0.034 W/m x K at 24 deg C) mean temperature.
   c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
   d. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
   e. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1

D. Cabinets

1. Material: Steel with factory prime coating, ready for field painting or baked-enamel finish with manufacturer's standard paint, in color selected by Architect or baked-enamel finish with manufacturer's custom paint, in color selected by Architect.
    a. Vertical Unit, Exposed Front Panels: Minimum 18 gage]sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners
    b. Horizontal Unit, Exposed Bottom Panels: Minimum 18 gage sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
    c. Recessed Flanges: Steel, finished to match cabinet.
    d. Control Access Door: Key operated.
    e. Base: Minimum 18 gage thick steel, finished to match cabinet, 4 inches high with leveling bolts.
    f. Extended Piping Compartment: 8-inch- (200-mm-) wide piping end pocket.
    g. False Back: Minimum 0.0428-inch- (1.1-mm-) thick steel, finished to match cabinet.

E. Filters
1. Minimum Arrestance: According to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
    a. 1” MERV 8

F. Hydronic Coils

1. General Coil Requirements: Test and rate hot water coils according to ASHRAE 33.
2. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain

G. Fan and Motor

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment.”
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

H. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls."

I. Basic Unit Controls (provided by TCC):

1. Control voltage transformer.
2. Wall-mounting temperature sensor.
3. Data entry and access port.
    a. Input data includes room temperature, and occupied and unoccupied periods.
    b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

J. DDC Terminal Controller (provided by TCC):

1. Controller shall have volatile-memory backup.

K. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net or LonWorks compatible for central BAS workstation and include the following functions (coordinate with TCC):

    a. Adjust set points.
    b. Cabinet unit heater start, stop, and operating status.
    c. Data inquiry, including outdoor-air damper position, supply-air and room-air temperature.
    d. Occupied and unoccupied schedules.
    e. Unoccupied Periods: Start fan and open control valve if room temperature falls below setback temperature.

4. Controller shall have volatile-memory backup.

L. Interface with DDC System for HVAC Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net or compatible for central DDC system for HVAC workstation and include the following functions:

    a. Adjust set points.
    b. Cabinet unit-heater start, stop, and operating status.
    c. Data inquiry, including [outdoor-air damper position and]supply-air and room-air temperature.
    d. Occupied and unoccupied schedules.

M. Electrical Connection: Factory-wired motors and controls for a single field connection.

N. Capacities and characteristics – See schedules on drawings

2.2 PROPELLER UNIT HEATERS

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

1. Daikin Applied
2. Berko, Marley International
3. Markel Products
4. Trane
5. Zhender Rittling
6. Raywall
7. Modine

B. Description

1. Factory-assembled and -tested unit complying with AHRI 440.
2. 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.
3. Comply with UL 2021.

C. Housing

1. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping
2. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

D. Hydronic Coils

1. General Coil Requirements: Test and rate hot water coils according to ASHRAE 33.
2. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.

E. Fan and Motor

1. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
2. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

F. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls."

G. Basic Unit Controls (provided by TCC):

1. Control voltage transformer.
2. Wall-mounting temperature sensor.
3. Data entry and access port.
   a. Input data includes room temperature, and occupied and unoccupied periods.
   b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

H. DDC Terminal Controller (provided by TCC):

1. Controller shall have volatile-memory backup.

I. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net or LonWorks compatible for central BAS workstation and include the following functions (coordinate with TCC):

   a. Adjust set points.
   b. Cabinet unit heater start, stop, and operating status.
   c. Data inquiry, including outdoor-air damper position, supply-air and room-air temperature.
   d. Occupied and unoccupied schedules.
   e. Unoccupied Periods: Start fan and open control valve if room temperature falls below setback temperature.

4. Outdoor-Air Damper Operation:

    a. Occupied Periods: Open dampers. Delay damper opening if room temperature is more than three degrees below set point.
    b. Unoccupied Periods: Close damper.

5. Controller shall have volatile-memory backup.

J. Interface with DDC System for HVAC Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net or compatible for central DDC system for HVAC workstation and include the following functions:

    a. Adjust set points.
    b. Cabinet unit-heater start, stop, and operating status.
    c. Data inquiry, including [outdoor-air damper position and]supply-air and room-air temperature.
    d. Occupied and unoccupied schedules.

K. Electrical Connection: Factory-wired motors and controls for a single field connection.

L. Capacities and characteristics – See schedules on drawings

2.3 WALL AND CEILING UNIT HEATERS

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

1. Daikin Applied
2. Berko, Marley International
3. Markel Products
4. Trane
5. TPI Corporation

B. Description

1. Factory-assembled and -tested unit complying with AHRI 440.
2. 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.
3. Comply with UL 2021.

C. Housing

1. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping
2. Front Panel: **Stamped-steel louver or** e**xtruded-aluminum bar grille**, with removable panels fastened with tamperproof fasteners.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1
4. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

D. Coils

1. General Coil Requirements: Test and rate hot water coils according to ASHRAE 33.
2. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.
3. Electric-Resistance Heating Coils
   a. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
   b. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
   c. Wiring Terminations: Stainless-steel or corrosion-resistant material.

E. Fan and Motor

1. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
2. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

F. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls."

G. Basic Unit Controls (provided by TCC):

1. Control voltage transformer.
2. Wall-mounting temperature sensor.
3. Data entry and access port.
   a. Input data includes room temperature, and occupied and unoccupied periods.
   b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

H. DDC Terminal Controller (provided by TCC):

1. Controller shall have volatile-memory backup.

I. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net or LonWorks compatible for central BAS workstation and include the following functions (coordinate with TCC):

   a. Adjust set points.
   b. Cabinet unit heater start, stop, and operating status.
   c. Data inquiry, including outdoor-air damper position, supply-air and room-air temperature.
   d. Occupied and unoccupied schedules.

e. Unoccupied Periods: Start fan and open control valve if room temperature falls below setback temperature.

4. Controller shall have volatile-memory backup.

J. Interface with DDC System for HVAC Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. Interface shall be BAC-net or compatible for central DDC system for HVAC workstation and include the following functions:

a. Adjust set points.
b. Cabinet unit-heater start, stop, and operating status.
c. Data inquiry, including [outdoor-air damper position and]supply-air and room-air temperature.
d. Occupied and unoccupied schedules.

K. Electrical Connection: Factory-wired motors and controls for a single field connection.

L. Capacities and characteristics – See schedules on drawings

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration Controls for HVAC."

D. Install wall and ceiling unit heaters to comply with NFPA 90A.

E. Install wall and ceiling unit heaters level and plumb.

F. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

G. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 232113 "Hydronic Piping," Section 232116 Hydronic Piping Specialties," Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 238239

SECTION 25 00 00 – INTEGRATED AUTOMATION AND HVAC CONTROL

PART 1 - GENERAL

1.01 INTERCONNECTION

A. The Building Automation Systems for the Winton Woods ESSER Renovations shall be integrated into the school district's existing Siemens Desigo CC BAS so that the owner can view and operate all the buildings from a common single interface.

1.02 BUILDING AUTOMATION SYSTEM DESCRIPTION

A. This Building Automation System (BAS) Contractor shall supply and install a complete BAS as required to accomplish the specified sequences of operation for control of heating, ventilating, air-conditioning and other building equipment and systems as described herein. All work in this Section shall be coordinated and provided by a single BAS Contractor. This system in its entirety shall comply with all the networking requirements of a BACnet® system as defined by the latest ASHRAE Standard 135-2016. This includes but is not limited to the following:

1. A Web-based GUI for day-to-day operations hosted on an Enterprise-Level BACnet® Operator's Workstation (B-OWS) as described below.

2. BACnet® Advanced Operator Workstation (B-AWS) as described below and listed in the plans and specifications. This workstation shall include all the necessary software to setup, configure and program all BAS system DDC controllers. This shall include any software whose function is to set network and configuration settings, program logic and create graphics including custom graphic libraries used in the creation of this project's graphics.

3. Direct digital controllers suitable to the applications and sequences as described herein.

4. All final control elements, (damper actuators, valve actuators, relays etc.) as required to meet the sequence of operations and suitable to the applications as specified.

5. Control valves as listed for BAS controlled equipment.

6. Integration to the following third party systems:

    a. Boiler(s) controls (as applicable).

    b. Boiler Flue control system (if applicable).

    c. Chiller(s) Controls (as applicable).

    d. Lighting Control Panel(s) (as applicable)

    e. Integral electric distribution metering (as applicable).

7. Integration to the above systems shall include making available to the BACnet internetwork all discoverable BACnet objects.

8. Installation and wiring of all ancillary control devices supplied by chiller and boiler manufactures as loose components to be field installed.

9. Line voltage controls as listed and specified, including any 120 V power necessary for the control equipment that is not shown on the Electrical Plans as having 120 V power provided by the project's Electrical Contractor.

10. Status monitoring of all exhaust fan statuses not specifically controlled by the BAS.

11. Low voltage non-DDC controls as listed and specified.

12. For attic stock the recommended spare parts as delineated in the submittals and record documents.

13. All licensing necessary to add the additional controllers to the existing Desigo CC GUI. WWCSD has coverage for software updates included in a service agreement. New controls and software adds provided as part of this project shall be included for routine updates and bug fixes to all software and firmware for a period of one (1) year.

14. Detail routine maintenance requirements for all system components.

B. The BAS shall consist of a high-speed, peer-to-peer internetwork of ANSI/ASHRAE 135 native BACnet® DDC devices. The control system shall also incorporate input/output devices, mechanical/electrical automatic temperature control devices, enclosures, interconnecting conduit and cabling.

C. The BACnet® operating stack must be embedded directly in each individual DDC device at the media access controller level and in all operator interface and configuration applications.

D. Communication gateways, bridges, protocol translators or any other device that translates any proprietary communication protocol to BACnet® shall not be permitted as a part of the BAS provided pursuant with this specification except as required to communicate to existing building systems.

E. All DDC devices shall be tested, certified, clearly stamped and listed by the BACnet® Testing Laboratories (BTL) prior to the bid date for this project. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

F. All logic required to perform the specified sequences of operation, trending and alarming as outlined in this specification shall reside in each individual DDC device. Should network communications fail, each device shall be capable of performing local control strategies without reliance upon any other device.

G. DDC devices that require any supervisory server software or hardware or any external platform to manage database execution or network management shall not be permitted as a part of the BAS provided pursuant with this specification

H. In multi-building sites each building shall be equipped with at least one user license for building operator to access BAS information from the District Wide Desigo CC Server for displaying all the graphics associated with that building.

I. WWCSD shall supply at least one PC for the BAS contractor to set up for use as an operator's workstation with all the necessary software and a full set of credentials for all software associated with the project at the project outset.

1.03 BAS ARCHITECTURE

A. BACnet®. The BAS as provided and installed under this specification shall comprise a BACnet® Internetwork. All communication shall conform to ANSI/ASHRAE Standard 135, BACnet®.

B. Consistency. The BAS as provided and installed under this specification shall be a complete system from a single manufacturer designed for use on intranets and the Internet.

C. Major Equipment/Plant Controller Requirements

1. Plant controllers must be a product capable of being purchased, serviced, and programed by the owner after occupancy
2. Allowable Manufacturers:
    a. Siemens Apogee with Desigo CC Graphics

D. FLCN. Field Level Communication Networks (FLCNs) shall be comprised of BACnet® networks of unitary BACnet® controllers and devices using the BACnet® data link Master Slave/Token Passing (MS/TP).

E. Device Controllers

1. Field devices must be freely programmable

2. Field bus must be BACnet MS/

3. Allowable Manufacturers

    a. Siemens

F. BLCN. Building Level Communication Networks (BLCNs) shall be comprised of a BACnet®/IP Local Area Network (LAN) for the interconnection of FLCNs, BACnet® devices and operator interfaces using the BACnet® data links BACnet®/IP (B/IP) or BACnet®/Ethernet (ISO 8802.3).

G. Internetwork. Internetwork operator interface and BACnet® communication shall be transparent to network architecture.

H. BACnet® communication shall be automatically routed to all configured BACnet® networks by DDC control devices on the internetwork. Dedicated, stand-alone BACnet® routers and/or routing devices shall be subject to approval prior to deployment. In all cases where a DDC controllers has integral routing capabilities this shall be the preferred method of BACnet® routing

1.04 REFERENCE STANDARDS

Workmanship, materials and equipment together with the resultant complete and operational BAS shall be in compliance with the Authorities Having Jurisdiction (AHJ) for the project and the most restrictive of applicable local, state and federal codes and ordinances in cooperation with these plans and specifications. At a minimum, the installation shall comply with the applicable sections of the current editions in effect thirty (30) days prior to receipt of bids of the following codes:

1. ANSI/ASHRAE Standard 135: BACnet® - A Data Communication Protocol for Building Automation and Control Networks.

2. National Electric Code (NEC).

3. National Electrical Manufacturers Association (NEMA), Enclosure for Electrical Equipment, General Standards for Industrial Controls.

4. All applicable state and local codes.

5. International Mechanical Code (IMC).

6. Underwriters Laboratories (UL).

7. UL-916 – Energy Management Systems (EMS).

8. UL-864/UUKL – Control Units and Accessories for Fire Alarm Systems.

1.05 WORK BY OTHERS

A. Installation of:

1. Automatic Control Dampers. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Mechanical Contractor.

2. Thermo-wells for hydronic system instrumentation.

3. Separable sockets, flow switches, flow sensors, and other in line pipe devices

4. Automatic Control Valves.

5. Airflow monitoring stations requiring modifications to ductwork other than a simple penetration into the ductwork.

6. Occupancy contacts shall be provided by the electrical contractor for integration into the BAS. It is the BAS Contractor's responsibility to wire from these contacts to appropriate BAS controller.

7. A dedicated 120 VAC circuit from breaker panel to within three (3) feet of panel is the responsibility of the Electrical Contractor. Sharing of circuit including neutral with other loads shall not be permitted.

8. CAT6 Ethernet network drops shall be installed to the BAS control panels where applicable by the Communications Contractor. The communications contractor shall terminate at the control panel to a jack within the panel. The BAS contractor shall insure that their panel has a designated location within the panel to accommodate this jack.

B. It is the BAS contractor's responsibility to assist in coordinating the locations of all sensing and final control elements associated with the BAS system. Ultimately it is the BAS contractor's responsibility to ensure instrumentation is located so as to provide optimal performance and conformance to the manufacturer's installation instructions and the requirements of this specification. Where minimum distances or tolerances cannot be met the contractor is to inform the owner in writing prior to final installation.

1.06 QUALITY ASSURANCE

A. BAS Manufacturer shall be engaged full-time in the manufacture of equipment and devices of the scope, size and service required.

B. The BAS Manufacturer shall operate a Quality Management System formally certified to be in compliance with ISO 9001:2008.

C. C. The BAS Contractor shall specialize and have a minimum of five (5) years of experience in the design, installation, programming and operation of Building Automation Systems (BAS) of the scope, size and service specified with at least ten (10) installations with similar network architectures; and shall:

1. Be an officially authorized representative of the BAS Manufacturer with an established relationship of not less than three (3) years with at least five (5) installations of comparative size and complexity. Submittals shall document this requirement with references.

2. Project managers and project engineers shall be officially trained and certified by the BAS Manufacturer in the design, installation, programming and operation of the BAS components and have at least five (5) years of experience in DDC installation projects with point counts similar to this project and systems of the same character as this project.

3. Project technicians shall be officially trained and certified by the BAS Manufacturer in the installation, programming and operation of the BAS components.

D. The DDC BACnet® Internetwork shall be based upon and installed according to the BAS Manufacturer's standard integrated hardware and software product design and in accordance with the Manufacturer's installation and application documentation.

1.07 SYSTEM PERFORMANCE

A. Graphic Display. A minimum of 50 dynamic real-time data points within 10 seconds of the request and shall refresh with current data within 5 seconds.

B. Operator Command. The maximum time between the command of a binary or analog object by the operator and the reaction initialization by the device shall be 5 seconds.

C. Object Command. Devices shall respond to automatic command of a binary or analog object within 2 seconds.

D. Object scan. Changes of state or analog shall be transmitted such that no reporting of a value is more than 15 seconds old.

E. Alarm Response. The maximum amount of time from when an object goes into alarm until it is annunciated at the workstation shall not exceed 20 seconds.

1. Each workstation on the network shall receive alarms within 10 seconds of other workstations.

F. Program Execution. All programs in all DDC devices shall be able to execute at a minimum of at least one time every second. Program execution time shall be configurable to be consistent with the process under control.

G. Control Loop Performance. All DDC devices shall be able to execute control loops at a frequency at least one time every second. The controller shall update the process value and output generated by this calculation at this same frequency at a minimum.

H. Environmental Conditions. All BAS components provided under this specification shall operate under ambient environmental conditions of -20°C (-4°F) to 55°C (131°F) dry-bulb and 10% to 90% relative humidity, non-condensing as a minimum. Sensors and control elements shall be constructed of material suitable and rated for the media sensed under the ambient environmental temperature, pressure, humidity, and vibration conditions encountered for the installed location.

I. Power Conditions. Networked components of the BAS shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

J. Reporting Accuracy. System shall report values with minimum end-to-end accuracy as listed in Table 1.

K. Control Stability and Accuracy. Control applications shall maintain process variables at set-point within the tolerances listed in Table 2.

1. Combined system repeatability of sensors, controllers and readout devices for a particular application shall be plus or minus 2% of full scale of the operating range.

2. Repeatability of overall combined system of sensor, controller and readout device in a control loop application will be plus or minus 5% of full scale of the operating range.

3. Long-term electronic drift shall not exceed 0.4% per year.

TABLE 1: REPORTING ACCURACY

PROCESS VARIABLE	REPORTING ACCURACY
Space Temperature	±0.5°C (±1.0°F)
Ducted Air Temperature	±1.0°C (±2.0°F)
Outdoor Air Temperature	±1.0°C (±2.0°F)
Water temperature	±0.5°C (±1.0°F)
Delta-T	±0.15°C (±0.25°F)
Relative humidity	±2% RH
Water flow	±2% of full scale
Air flow (terminal)	±10% of full scale (Note 1)
Air flow (measuring stations)	±2% of full scale
Air flow (pressurized spaces)	±3% of full scale
Air pressure (ducts)	±25 Pa (±0.1 in. WG)
Air pressure (space)	±3 Pa (±0.01 in. WG)
Water pressure	±2% of full scale (Note 2)
Electrical Power (A , W, V & PF)	±2% of reading (Note 3)
Carbon Monoxide (CO)	±10% of reading
Carbon Dioxide (CO_2)	±40 PPM

NOTE 1: Accuracy applies to 10%-100% of scale

NOTE 2: For both Absolute and Differential pressure

NOTE 3: Not including utility-provided meters

TABLE 2: CONTROL STABILITY & ACCURACY

PROCESS VARIABLE	CONTROL ACCURACY	RANGE OF MEDIUM
Air Pressure	±50 Pa (±0.2 in. WG) ±3 Pa (±0.01 in WG)	0-1.5 kPa (0-6 in. WG) -25-25 Pa (-0.1-0.1 In. WG)
Terminal Unit Air flow	±10% of full scale	
Airflow Monitoring Stations Ducted	+/- 3% of reading	0-5000 fpm
Airflow Monitoring Stations Non-ducted	+/- 5% of reading	0-5000 fpm
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3.0°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 kPa (±1.0 in. WG)	0-1 MPa (1-150 psi) ΔP 0-12.5 kPa (0-50 in WG) ΔP
Carbon Monoxide	+/- 2% of reading	0-200 ppm 0-1000 ppm
Carbon Dioxide	+/- 3% of reading	0-2000 ppm 0-5000 ppm

1.08 SUBMITTALS

A. Equipment and systems requiring approval by the Authority Having Jurisdiction (AHJ) must comply and be approved prior to submittal. Approval shall be at the expense of the BAS Contractor. Provide a copy of all related correspondence and permits to the Owner.

B. Submit in compliance with all General Conditions of the Contract, Supplementary Conditions and General Requirements of the project and in conjunction with the requirements of this section.

C. No work may begin on any segment of this project until submittals have been successfully reviewed for conformity with the design intent.

D. All submittals and documentation including complete BAS engineering design submittal & drawings, project record documents, application engineering documents and owner's & maintenance manuals shall be submitted electronically in the form of an ISO 32000 Portable Document Format (PDF). In addition three (3) paper copies formatted as described below shall be submitted. All control schematics, wiring diagrams, riser diagrams, etc. shall be formatted for A3 paper size (297mm x 420mm, 11" x 17"). All other documentation may be formatted for A4 (210mm x 297mm, 8.5" x 11").

E. Submit in writing and so delineated at the beginning of each submittal, known conflicts, substitutions and deviations from requirements of Contract Documents. Deviation from Contract Documents must be approved by Owner and/or contracting officer prior to award of contract.

F. Each submitted piece of literature and drawing shall clearly reference the applicable specification section and/or drawing that the submittal responds to. General catalogue sheets shall not be acceptable as cut sheets.

G. Submittal documentation and drawings shall consistently use the same abbreviations, symbols, nomenclature and identifiers. Each control system element shall be assigned a unique identifier pursuant with the Contract Documents.

H. Submittal documentation and drawings shall have at the beginning an index and design drawing legend.

1. Index shall list all design drawings and elements including the drawing number, sheet number, drawing title, etc.

2. Legend shall show and describe all symbols, abbreviations and acronyms used on the design drawings.

I. Provide a schedule of work indicating at a minimum the intended sequence of work, start dates and durations for individual activities, delivery dates for major materials and equipment including anticipated lead times and milestones indicating possible restraints on work by other trades or construction delays.

J. BAS Hardware Submittals.

1. A complete bill of materials of all equipment, controllers, devices and sensors to be provided and/or used indicating unique equipment identifier, unique device identifier, manufacturer, model number and quantity.

2. A Protocol Implementation Conformance Statement (PICS) including a BACnet® Interoperability Building Block (BIBB) table for each DDC device included in the submittal.

3. Manufacturer's technical data including product specification sheets, performance curves and installation/maintenance instructions. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly called out by other means.

4. Schematic diagrams for all field sensors and controllers providing floor plans indicating the locations of all sensors, devices and temperature control panels.

5. Typical sample graphics depicting typical floorplans, system graphics, tabular informational graphics etc... Any use of owner logos or other copyrighted material must be approved by the owner. Color schemes and general layout are subject to approval.

6. Control enclosure details for each enclosure including panel identifier, location, physical lay-out, dimensions, instrumentation, labels, etc.

7. Wiring diagrams and schematics for each control enclosure showing and power source for each panel, secondary power and network termination as well as all individual terminations, terminal numbers, point type and mnemonic/name.

8. Wiring diagrams for all packaged equipment, motor starters, relay wiring, equipment interlock, safety circuits, etc. clearly indicating all interconnecting wiring and termination of all conductors and cables including labels of all cables and point mnemonics.

9. Wiring diagrams and schematics for each sensor.

10. A list of recommended spare parts.

K. Controlled System Submittals.

1. Riser diagram showing the physical lay-out of the entire Internetwork.

2. Riser diagram for each individual BACnet® network including the ELCN, and each BLCN and FLCN including:

3. Data link with physical characteristics and configuration.

4. Each BACnet® networked DDC device including location, service, device instance, MAC address and network number.

5. Each IP networking device including location, service and IP address.

6. Location of all interface devices including network interface jacks and workstation connections.

7. Location of all MS/TP network termination points and End-of-Line terminations.

8. A schematic control flow diagram of each controlled system showing actual physical configuration and location of all control elements including each hardware point type, controller and mnemonic.

9. A schematic wiring diagram of each controlled system showing actual physical wiring and termination of all control elements including each hardware point type, controller, mnemonic and terminal number.

10. An instrumentation list for each controlled system displaying each control element, name, manufacturer, model and product data sheet number in a tabular format.

11. A complete description of the operation of the BAS including a specific Sequence of Operation for each controlled system. Sequences of operation shall:

12. Reference the submitted schematic of the controlled system.

13. Refer to equipment and control devices by their specific unique identifiers pursuant with the Contract Documents and the BAS submittal package.

14. Clearly represent actual application programming methodology and functional control operation not merely a copy of the Contract Document specified sequence of control.

15. Include a concise description of functional system operation under specified normal and failure conditions.

16. Include a complete hardware input and output (I/O) points schedule identifying for each point its instance, type, name/mnemonic, controller, equipment/function, location, termination, and override, alarm and display criteria.

17. Operational deviation from the specified Sequences of Operation as outlined in Contract Documents shall not be permitted under any circumstances without prior written approval.

18. A schedule of all control valves including the unique equipment identifier, valve size, dimensions and installation/maintenance clearance, model number (including pattern and connections), close-off rating, flow, CV, pressure drop, pressure rating and location. The valve schedule shall also contain actuator selection data supported by calculations of the force required to move, close and seal the valve at design conditions, and fail position/normal position.

19. A schedule of all control dampers. This shall include the unique equipment identifier, unique damper identifier, damper size, pressure drop, blade configuration, orientation and axis of frame, blade rotation, location and selection criteria of actuators, nominal and actual sizes, and manufacturer and model number. The Damper Schedule shall include the SMACNA maximum leakage rate at the operating static-pressure differential, and fail position/normal position

20. A VAV box schedule indicating the VAV box identifier, minimum heating and cooling cfm values, box diameter, box effective area, AHU providing primary air, room number served, zone sensor designation (where multiple VAVs serve a common zone), and final calibration factor. The calibration factor is to be recorded after final balancing.

21. A list of recommended spare parts.

L. Network IP Requirements

1. The contractor is to submit a list of all IP network requirements to implement their control system communications requirements as designed. This is to include requests for IP addresses, UDP and TCP ports that will need to be opened to allow communications.

2. A list of all requirements necessary for offsite access to system for service personnel and owner maintenance personnel.

3. All IP communications are subject to the approval of the owner's IT personnel and must be coordinated with them.

1.09 PROJECT RECORD DOCUMENTS

A. Upon completion of installation, systems commissioning and notice of contract completion, submit record (as-built) documents. Provide one complete set of operation and maintenance manuals in a three-ring notebook and organized by subject, by systems and by equipment with divider tabs Operation and Maintenance (O&M) manual to include the following:

1. Table of Contents

2. Names and 24-hour contact information for installing contractors and service representatives.

3. Licenses, guarantees and warrantee documentation for all equipment and systems.

4. Testing and commissioning reports and checklists.

5. Certificate of Instruction of Owner Personnel.

6. As-built revisions of all submittal data updated to reflect actual field conditions, architecture and execution.

7. Operator's manual with administrator and operator level credentials and procedures for operating the BAS including logging-on/off, handling alarms, generating points reports, trending data, overriding automatic control, changing set-points and control variables.

8. Programming manual describing the programming language structure and syntax.

9. Engineering manual describing database management and modification.

10. Installation and maintenance manuals describing how to install and configure new hardware as well as how to perform routine preventative maintenance and calibration together with corrective diagnostic troubleshooting procedures.

11. Documentation of all programs created including set-points, tuning parameters and final database.

12. Complete system database as functional at the conclusion of systems commissioning and functional testing including all graphics and images used by and/or created for BAS on electronic format as accepted by Owner.

13. Final Bill of Material with all installed parts, manufacturers, manufacturers' part numbers and ordering information.

14. A schedule of recommended spare parts with part numbers and supplier.

15. All original-issue installation and maintenance manuals, user guides, and other documentation provided with all hardware and software provided as a part of this specification.

16. Licenses, guarantees and warranty documentation for all equipment and systems.

B. In addition to the binders, the entire Operation and Maintenance Manual shall be furnished on digital portable media. The Operation and Maintenance Manual shall be self-contained, and include all necessary software required to access the project record drawings and data sheets. A logically organized table of contents shall provide dynamic links to view and print all project record drawings and product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents. The digital media shall contain adequate space for future system update.

C. After completion of all final tests and adjustments, the contractor shall install a digital copy of the O&M manuals on the Enterprise-Level BACnet® Operator's Workstation (B-OWS). This manual shall be accessible via a dynamic link embedded in the "Home Page" of the system.

1.10 TRAINING

A. All training at the site shall utilize specified manuals, as-built documentation, and the on-line help utility. All training sessions shall be videotaped. Submit two copies of the training session(s) prior to project contract completion.

B. Trainers shall be qualified contractor personnel familiar with all aspects of the BAS system as installed on site.

C. Training shall be specific to the site.

D. All training materials and equipment (i.e. projectors, training PCs etc.) shall be provided by the contractor. Coordinate with the building owner for site training location and personnel who will be attending.

E. Upon completion of the work and acceptance by the Owner, provide six four-hour periods of instruction to the Owner's operating personnel who have responsibility for operating and maintaining the BAS system. Provide two periods of training at the end of Construction Phase and two periods at the beginning of the first winter, and the remaining two at the beginning of the first summer. The BAS Manufacturer shall make available to the Owner regularly scheduled training courses for the ongoing training of the Owner's operating personnel.

1.11 WARRANTY

A. The BAS Manufacturer shall warranty all DDC controllers to be free of defect in material and workmanship under normal operation and expected service as published by the manufacturer in the unit's performance specifications for a period of one (1) year at a minimum.

1. Sensors and field components integral to DDC controllers shall be warrantied to be free of defect in material and workmanship under normal operation and expected service as published by the manufacturer in the unit's performance specifications for a period of one (1) years at a minimum.

B. The BAS Contractor shall warranty the installation of all other DDC materials and labor to be free of defects under normal expected service and use for a period of one (1) year from the date of final acceptance.

C. BAS failures during the installation warranty period shall be adjusted, repaired or replaced at no additional cost or reduction in service to the Owner. Except in the event of property loss or damage, warranty service shall be provided during regular working hours Monday through Friday. The BAS Contractor shall respond to failure notifications from the Owner within twenty four (24) hours. Repair or replacement of failed components will be schedule as soon as practical.

D. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user digital media. At the end of the warranty period, the Contractor shall prepare three duplicate copies of all control software on digital media. Two copies, complete with hardware and software interfaces and full down-line reloading instructions, shall then be turned over to the Owner.

E. The BAS Contractor shall maintain an on-site record of all work done, all items removed from site, all items returned to the site, all new replacement items installed and all remedial programming, database entry work and recalibration undertaken including software revisions installed as a result of Warranty service.

F. The BAS Contractor shall maintain an off-site record of the most recent database and control system drawings for restoration in the event of a catastrophic system failure.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project specific licenses, software, and documentation shall become the Owner's property including but not limited to graphics, record drawings, database, application programming code and documentation upon project acceptance.

B. The Owner retains the right to allow and/or prohibit access to all aspects of the system solely at their discretion.

1.13 MATERIAL DELIVERY AND STORAGE

A. The contractor is to coordinate with the general contractor all on-site laydown and material storage locations.

B. The contractor is to keep a current list of all on-site stored material.

C. The contractor is to provide adequate documentation of any material stored off-site and listed as stored material in the AIA billing documents.

D. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

PART 2 - PRODUCTS

2.01 ACCEPTABLE INSTALLERS AND MANUFACTURERING REQUIREMENTS

A. All DDC devices shall be tested, certified, clearly stamped and listed by the BACnet® Testing Laboratories (BTL) prior to the bid date for this project. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

B. The order of installers does not indicate preference. Inclusion on this list does not guarantee acceptance of products or installation. Building Automation Systems (BAS) shall comply with all of the requirements of this specification.

C. The following are approved BAS installers:

1. Siemens Factory Owned Branch Office

D. All BAS networked devices specified herein including advanced operator workstations, operator workstations, controllers and routers shall be provided by a manufacturer previously used by the installers listed above who is credentialed to install such devices.

1. OEM and/or private-labelled controllers or software manufactured or developed by a third-party and labelled or otherwise represented as being a product of one of the allowable manufacturers listed above shall not be accepted under this specification.

E. Other non-networked system components specified herein (including sensors, valves, dampers, etc.) need not be manufactured by the above manufacturers.

F. The BAS Manufacturer product line selected shall be the most current and complete offering from the manufacturer and shall currently be actively manufactured and supported at the time that this project is bid.

G. This project shall not be used as a test site. First release and test version hardware, software and firmware shall not be implemented on this project under any circumstances.

H. BAS devices and spare components or equivalent shall be readily available for a minimum of five (5) years after the completion and final acceptance of this project.

2.02 NETWORK COMMUNICATIONS

A. The BAS as provided and installed under this specification shall comprise a BACnet® Internetwork. All communication shall conform to ANSI/ASHRAE Standard 135, BACnet®.

B. Each individual DDC device shall provide a communication port for the connection of an operator workstation. The BAS contractor shall provide as part of this contract any necessary specialized hardware (cables, connectors, converters etc.) to facilitate this connectivity.

C. The BAS shall be modular in nature and implemented in such a manner that it can be expanded in both capacity and functionality through the addition of DDC controllers, devices and wiring. Expansion shall not require operator interface or configuration hardware additions, software revisions or hardware, operating system/feature licensing.

D. All BAS BACnet® networked devices with Real-Time Clocks (RTCs) shall utilize the BACnet® Time Synchronization service. The System shall automatically synchronize system clocks from a designated Time Master periodically via the Internetwork. The System shall also automatically adjust for configurable Daylight Savings Time and Standard Time as applicable.

2.03 ENTERPRISE-LEVEL BACNET® OPERATOR WORKSTATION (B-OWS)

A. Purpose.

1. The enterprise-level BACnet® operator workstation (B-OWS) provides day-to-day monitoring and operation of individual DDC Systems and multiple BACnet® internetworks through a browser-based user interface (BUI).

B. The enterprise-level B-OWS shall be a native BACnet® device.

1. The BACnet® operating stack must be embedded in the application core.

2. Communication gateways, bridges, protocol translators or any other device that are required to translate BACnet to any proprietary communication protocol for the enterprise-level B-OWS shall not be permitted as a part of this specification.

C. BACnet.

1. The enterprise-level B-OWS provided shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2010 Revision 12 Annex L a minimum of 30 days prior to the bid date for this project as follows:

2. BACnet Operator Workstation (B-OWS).

D. BACnet Networking.

1. The enterprise-level B-OWS shall natively support the following BACnet data links as specified in ANSI/ASHRAE Standard 135 and in compliance with the following physical layer standards at a minimum.

2. BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.

E. Software. The enterprise-level B-OWS must be designed to operate as a Microsoft service in a multitasking environment concurrent with other common software applications.

F. Security. The enterprise-level B-OWS shall support multilayered system security permissions that can be defined for each individual operator to restrict/permit day-to-day operations and system configuration.

1. The enterprise-level B-OWS shall support Active Directory integration for assigning and enforcing security credentials and policies for operators.

G. Browser-based User Interface (BUI). The enterprise-level B-OWS shall use a graphically-oriented browser-based user interface (BUI).

H. Alarm Processing. The enterprise-level B-OWS shall display and log BACnet alarms and events from any object in the BACnet internetwork.

I. Scheduling. The enterprise-level B-OWS shall support viewing and modification, of standard binary, analog, and multistate BACnet Schedule objects and parameters.

J. Trend Logs. The enterprise-level B-OWS shall support viewing, modification, creation, and deletion of custom trend logs for any data object in the system.

2.04 BACNET® ADVANCED OPERATOR WORKSTATION (B-AWS)

A. The BACnet® Advanced Operator Workstation provides complete configuration, monitoring, modification and operation of the entire BAS by advanced building operators and technicians.

B. BACnet® Advanced Operator Workstation software shall comply with the minimum requirements of ANSI/ASHRAE Standard 135 Annex L for a B-AWS and shall be certified and listed by the BACnet® Testing Laboratories (BTL) as a B-AWS prior to the bid date for this project. BTL product listings are available from BACnet® International at (http://www.bacnetinternational.net/btl/).

C. BACnet® Advanced Operator Workstation shall reside on the ELCN or the BLCN using the BACnet®/IP data link as specified in ANSI/ASHRAE Standard 135.

D. Security

1. Each operator shall be required to log on to the system with a unique user name and password in order to view, edit, add or delete data.

2. System security permissions shall be multilayered and defined for each individual operator to restrict/permit day-to-day operations and system configuration.

3. An administrator-level operator shall have the ability to configure credentials for all other operators.

4. Each operator shall be automatically logged-off of the system after a configurable period of inactivity.

5. Security data shall be stored in an encrypted format.

E. Database Back-up & Restore.

1. Each workstation shall provide operator interface and off-line storage of system information. An operator with the proper permissions shall be able to back-up, restore and/or clear the database from any device on the Internetwork.

2. The workstation shall perform automated network back-up of runtime databases in all devices on the BACnet® internetwork according to operator configurable schedule and storage directory structure.

F. System Configuration.

1. The workstation shall provide a complete standalone engineering tool for the configuration of the system without assistance from any controls contractor. This shall allow for future system changes under proper password protection including dynamic creation, deletion and modification of all configuration parameters, programs, graphics, trend logs, alarms, schedules and every BACnet® object used in the installed system.

G. Online Help.

1. Provide a context-sensitive online help system to assist the user in operation and modification of the system. Online help shall be available for all system applications and shall provide the relevant data for the active window or screen. Additional help shall be available through the use of hypertext.

H. System Diagnostics.

1. The workstation shall be provided with fully automatic verification of internetwork communication. In the event of communications failure, the system shall automatically Alarm the condition. B-AWS Software shall be capable of remote annunciation to printer, pager and e-mail.

I. Graphical User Interface (GUI).

1. The operator interface shall be graphically oriented

2. All color graphic displays shall be dynamic with current point data automatically updated from the BACnet® internetwork to the workstation without operator intervention.

3. With the proper credentials the operator shall be able to manually adjust all data point values (hardware or software) in the system, adjust control loop parameters, schedules and command points to manual override, timed override and automatic mode.

4. Operators shall have the ability to dynamically create messages saved as text files on the B-AWS associated with individual objects on a display or the display itself. These text files may be viewed and modified by other operators during other sessions.

5. The windowing environment of the workstation shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, and/or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

6. Operator shall be able to easily navigate between the graphic displays and shall be able to individually change the size and location of the displays on the screen.

7. B-AWS software shall support at a minimum BMP, GIF, TIF, JPG, EMF, PNG, SWF and DIB graphic file formats and allow for the use of custom animation objects and URL hyperlinks in each display.

8. The operator shall have the ability to generate custom dynamic images for graphical representation of system design and system parameters. Graphic images may reside on a workstation or server; however, all dynamic data and attributes must reside in each controller.

9. Library of standard HVAC graphic components consistent with the delivered graphics shall be available to the Owner including all of the equipment and standard symbols used in a file format compatible with the B-AWS software.

J. Alarm Processing.

1. The workstation shall display and log alarms and events from any BACnet® object in the system and shall support operator configuration of the alarm limits, differentials, states and reactions for each object in the system.

2. Alarm Classification. System shall provide a minimum of 20 configurable notification classes and 50 configurable alarm priorities.

3. Alarm and Event Log. The operator shall be able to view all system alarms from any location in the internetwork. With the proper credentials, an operator shall be able to acknowledge and clear alarms. Alarm and Event Log shall be configurable per workstation and shall display at a minimum alarm time, received time, state, notification class, priority, message, source, time acknowledged, acknowledged by user and action.

    1) Acknowledged and Cleared alarms shall be saved to the hard disk of the workstation.

4. Alarm Messages. Alarm messages shall use the English language name for the object in alarm in such a way that the source, location and nature of the alarm is easily understood without relying upon mnemonics or object instances.

    1) Alarm messages shall be fully customizable in size, content, behavior and sound.

5. Alarm Actions. The operator shall be able to configure any of the following automatic alarm actions per workstation.

    1) Logging.

    2) Printing.

    3) Starting programs or routines.

    4) Displaying messages.

    5) Paging.

    6) Displaying specific graphical displays or files.

    7) Sending emails.

    8) Sending text messages.

K. Scheduling.

1. The workstation shall support viewing and with proper user credentials, modification, creation and deletion of binary, analog and multistate BACnet® Schedule objects and parameters.

2. The schedule objects shall reside in each individual device. Workstation or server-based scheduling shall not be acceptable.

3. Each schedule shall display the scheduled transitions for the calendar week. Each calendar day shall support up to a minimum of ten (10) transitions and each transition shall be modifiable via the workstation graphically or via manual entry.

4. Display a monthly calendar allowing for indication and modification of Exception Schedules for any calendar day.

    1) Each Exception Schedule and holiday shall be individually configurable including name, priority, transition values and times.

    2) The operator shall have the ability to configure Exception Schedules to be active on specific dates, date ranges, recurring date patterns or as commanded by BACnet® Calendar objects or other override objects.

L. Trend Logs.

1. The workstation shall support both the BACnet® Trend Log and the BACnet® Trend Log Multiple standard objects for defining custom trend logs for any object in the system. This definition shall include interval, length, start time and end time.

2. The trend data shall be sampled and stored in each individual BACnet® device where the object is stored. The workstation or another field level integration platform shall not be required for storage of custom trend logs.

3. All long-term data archival to hard-disk shall be performed by a BTL-Listed BACnet® device dedicated for this service.

4. The workstation shall display all trend log data in a tabular and graphical format.

5. All trend log data shall be able to be exported as a CSV or XLS and printed.

6. The workstations shall display trend log data from controllers and archived BACnet® data from the archive server database seamlessly, in the same trend log display.

M. Runtime Logs.

1. The workstation shall support logging and reporting of runtime for every binary object in the system.

2. Runtime data shall be sampled and stored in each individual BACnet® device where the object is stored using standard BACnet® objects and published properties. The workstation shall not be required for storage of custom runtime logs.

3. At a minimum, the Runtime data shall include: total accumulated active time, total accumulated active transitions, and active transitions for the current day, timestamp and duration for each change of state for the last 100 transitions.

N. Object and Property Status and Control.

1. The workstation shall provide a method for the operator to view and if permitted modify the status and present value of any standard object and property in the system.

2. The operator shall be able to build custom reports manually or by performing wildcard searches for object instances, mnemonics or names.

2.05 EMBEDDED BACNET® OPERATOR WORKSTATION (B-OWS)

A. The embedded BACnet® Operator Workstation (B-OWS) provides day-to-day monitoring and basic operation of the BAS. The embedded BACnet® Operator Workstation is not designed for configuration of the System.

B. The embedded BACnet® Operator Workstations shall comply with the minimum requirements of ANSI/ASHRAE Standard 135 Annex L for both a B-OWS and a B-BC and shall be certified and listed by the BACnet® Testing Laboratories (BTL) as both a B-OWS and a B-BC prior to the bid date for this project. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

C. Embedded BACnet® Operator Workstations shall reside on the ELCN or the BLCN using the BACnet®/IP data link as specified in ANSI/ASHRAE Standard 135 Annex J.

D. Each embedded BACnet® Operator Workstation shall store the entire device database and all necessary Graphical User Interface (GUI) resources including animations locally on the device. Web-enabled applications that require system graphics to be stored on the client machines or servers shall not be acceptable.

E. Security.

1. Each operator shall be required to log on to the system with a unique user name and password in order to view, edit, add or delete data.

2. System security permissions shall be multilayered and defined for each individual operator to restrict/permit day-to-day operations and system configuration.

3. Each operator shall be automatically logged-off of the system after a configurable period of inactivity.

4. Security data shall be stored and transmitted in an encrypted format.

F. Graphical User Interface (GUI).

1. The operator interface shall be graphically oriented.

2. All color graphic displays shall be dynamic with current point data automatically updated from the BACnet® internetwork to the embedded workstation without operator intervention.

3. The operator with the proper credentials shall be able to manually adjust all data point values (hardware or software) in the system, adjust values of control loops, and command points to manual override, timed override and automatic mode.

4. Operators shall have the ability to dynamically create messages saved a text files on the embedded B-OWS associated with individual objects on a display or the display itself. These text files may be viewed and modified by other operators during other sessions.

G. Alarm Processing.

1. The embedded workstation shall display and log alarms and events from any BACnet® object in the system and shall support operator configuration of the alarm limits, differentials, states and reactions for each object in the system.

2. Alarm Classification. System shall provide a minimum of 20 configurable notification classes and 50 configurable alarm priorities.

3. Alarm and Event Log. The operator shall be able to view all system alarms from any location in the internetwork. With the proper credentials, an operator shall be able to acknowledge and clear alarms. Alarm and Event Log shall display at a minimum alarm time, received time, state, notification class, priority, message, source, time acknowledged, acknowledged by user and action.

4. Alarm Messages. Alarm messages shall use the English language name for the object in alarm in such a way that the source, location and nature of the alarm is easily understood without relying upon mnemonics or object instances.

    1) Alarm messages shall be fully customizable in size, content and behavior.

5. Alarm Actions. The operator shall be able to configure any of the following automatic alarm actions per workstation.

    1) Logging.

    2) Printing.

    3) Starting programs or routines.

    4) Displaying messages.

    5) Paging.

    6) Displaying specific graphical displays or files.

    7) Sending emails.

    8) Sending text messages.

H. Scheduling.

1. The embedded workstation shall support viewing and with proper user credentials modification of BACnet® binary, analog and multistate Schedule objects and parameters.

2. The schedule objects shall reside in each individual device. Workstation or server-based scheduling shall not be acceptable.

3. Each schedule shall display the scheduled transitions for the calendar week. Each calendar day shall support up to a minimum of ten (10) transitions and each transition shall be modifiable via the workstation graphically or via manual entry.

4. Display a monthly calendar allowing for indication and modification of Exception Schedules for any calendar day.

1) Each Exception Schedule and holiday shall be individually configurable including name, priority, transition values and times.

2) The operator shall have the ability to configure Exception Schedules to be active on specific dates, date ranges, recurring date patterns or as commanded by BACnet® Calendar objects or other override objects.

I. Trend Logs.

1. The embedded workstation shall support both the BACnet® Trend Log and the BACnet® Trend Log Multiple standard objects for defining custom trend logs for any object in the system. This definition shall include interval, length, start time and end time.

2. The trend log data shall be sampled and stored in each individual BACnet® device where the object is stored. The workstation shall not be required for storage of custom trend logs.

3. All long-term data archival to hard-disk shall be performed by a BTL-Listed BACnet® device dedicated for this service.

4. The workstation shall display all trend log data in a tabular and graphical format.

5. All trend log data shall be able to be exported as a CSV or XLS and printed.

6. The embedded workstations shall display trend log data from controllers and archived BACnet® data from the archive server database seamlessly, in the same trend log display.

J. Runtime Logs.

1. The embedded workstation shall support logging and reporting of runtime data for every binary object in the system.

2. Runtime data shall be sampled and stored in the individual BACnet® device where the object is stored using standard BACnet® objects and published properties. The workstation shall not be required for storage of custom runtime logs.

3. At a minimum the Runtime data shall include: total accumulated active time, total accumulated active transitions, and active transitions for the day, timestamp and duration for each change of state for that last 100 transitions.

2.06 BACNET® DATA ARCHIVE SERVER

A. Acquisition of trend log data for archival and long-term secure storage of trend log data shall be performed by a BTL-Listed BACnet® device dedicated to this service. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

B. BACnet® Data Archive Server shall reside on the ELCN or the BLCN using the BACnet®/IP data link as specified in ANSI/ASHRAE Standard 135 Annex J.

C. BACnet® Data Archive Server shall support at a minimum the following BACnet® Interoperability Building Blocks (BIBBs) as supported by the submitted PICS:

1. Data Sharing-ReadProperty-A (DS-RP-A).

2. Data Sharing-ReadProperty-B (DS-RP-B).

3. Data Sharing-ReadProperyMultiple-A (DS-RPM-A).

4. Data Sharing-ReadPropertyMultiple-B (DS-RPM-B).

5. Data Sharing-WriteProperty-A (DS-WP-A).

6. Trending-Automated Trend Retrieval–A (T-ATR-A).

7. Trending-Automated Multiple Value Retrieval-A (T-AMVR-A).

8. Trending-Archival-A (T-A-A).

9. Device Management-Dynamic Device Binding-A (DM-DDB-A).

10. Device Management-Dynamic Device Binding-B (DM-DDB-B).

11. Device Management-Dynamic Object Binding-B (DM-DOB-B).

D. At a minimum, the BACnet® data archive server shall be capable of performing the following:

1. Automatically retrieving the data from all BACnet® Trend Log and BACnet® Trend Log Multiple objects from any BACnet® device communicating on the internetwork without user-intervention.

2. Automatically manage the connection to the internetwork based upon configurable data acquisition thresholds; retrieving data only when necessary rather than streaming data.

3. Generate a standard, secure SQL database accessible by third-party applications.

4. Operate as a Microsoft Windows service.

5. Archived data shall be limited only by SQL license and hard disk space available.

6. BACnet® Advanced Operator Workstations (B-AWS), BACnet® Operator Workstations (B-OWS) and enterprise level BACnet® web servers shall display trend log data from controllers and archived BACnet® data from the archive server database seamlessly in the same trend log display.

2.07 CONTROLLERS

A. BACnet® Compliance. All DDC controllers shall be tested, certified, clearly stamped and listed by the BACnet® Testing Laboratories (BTL) prior to the bid date for this project. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

B. Specification Compliance. All DDC controllers shall comply with the general requirements of all parts of this specification.

C. Application. Each individual mechanical system or piece of equipment shall be controlled by no more than one (1) dedicated controller with sufficient hardware and database capacity such that it shall be connected to all field devices and sensors associated with that system and/or piece of equipment.

1. Distributed control of one (1) single piece of mechanical equipment shall not be performed by multiple controllers.

D. Memory. Each controller shall have sufficient memory to support its operating system, database, and programming requirements. Battery/capacitor shall maintain programming and clock memory and functions for a minimum of 72 hours.

1. Each controller shall provide microprocessor based self-contained stand-alone fully programmable operation of local process control loops. All local level application programs shall be installed on individual controllers in non-volatile memory.

E. Updates. All controllers shall permit simple operating system firmware updates at any time after installation, utilizing the BACnet® network. Operating system firmware that requires chip replacement or flash modification will not be acceptable.

F. Data Sharing. Each controller shall be capable of locally executing global strategies for the BAS based on information from any object in the internetwork. Control systems that require a higher-level host processor for update, time stamps, global point data, COS transfer, on-line control instruction, or communications control between panels shall not be acceptable.

G. Serviceability. Each DDC controller shall be provided with diagnostic LEDs for power, communication and processor. All wiring connections shall be made to field-removable, modular terminal strips.

H. Universal Inputs. All hardware inputs on all controllers shall be of the universal type and shall support the following physical characteristics at a minimum.

1. Dry-contact.

2. Pulse/Pulse-width accumulation.

3. Resistance.

4. Voltage.

5. Current.

6. 24 VAC over-voltage protection.

I. Universal Outputs. All controllers with universal type hardware outputs and shall support the following physical characteristics at a minimum:

1. Contact closure.

2. Analog/Modulating.

3. 24 VAC over-voltage and short protection.

J. Operator Override. All BACnet® Building Controllers (B-BC) shall support operator-initiated timed overrides of hardware and software objects with user-configurable override periods. When the override period has expired, the controller shall automatically return the object to the automatic state without any additional action on the part of the Operator.

1. The timed override functionality shall exist entirely in the controller. A workstation shall not be required for the execution of the time period nor for returning the object to automatic.

K. Database. Programming, configuration and modification shall be accomplished via the Internetwork from the B-AWS. The complete operational database and application program shall reside in each individual controller.

1. All controllers delivered as a part of this specification shall be configured using one (1) common B-AWS. Devices that require custom applications for configuration shall not be acceptable.

2. The controllers shall function in a real-time, multi-tasking networked operating environment; able to display database values, programs, and control loops in real-time while functional and online using the B-AWS. The user shall be able to add, delete, or modify objects on-line as required without taking the controller offline. The programming shall provide all the necessary mathematics, logic, utility and control functions necessary to execute the specified sequence of control.

L. Programmability. All controllers shall be freely-programmable and support custom control strategies, programs and databases that are completely modifiable over the BACnet® Internetwork once installed.

1. All controllers delivered as a part of this specification shall be programmed using one (1) common programming language, means and method via the B-AWS. Devices that require custom applications for configuration shall not be acceptable.

2. Control systems that exclusively utilize configurable-only ‘canned’ programs or programmable read only memory (PROM) level application programming are not acceptable.

M. Alarm Processing. A controller’s ability to report alarms shall not be affected by either operator activity, execution of programs or communications with other controllers on the network.

N. Scheduling. All controllers shall support the standard BACnet® Schedule and BACnet® Calendar objects.

1. Schedule objects shall reside in each individual device. Workstation or server-based scheduling shall not be acceptable.

2. BACnet® Schedule objects shall support binary, analog, and multi-state values.

3. Each calendar day shall support up to a minimum of ten (10) transitions.

4. BACnet® Schedule objects shall be able to directly command any BACnet® object in the internetwork without requiring custom programming.

5. Exception Schedules shall be configurable for any calendar day.

6. Each Exception Schedule and holiday shall be individually configurable including name, priority, transition values and times.

7. The operator shall have the ability to configure Exception Schedules to be active on specific dates, date ranges, recurring date patterns or as commanded by BACnet® Calendar objects or other override objects.

O. Trending. All BACnet® Building Controllers (B-BC) shall support both standard BACnet® Trend Log and BACnet® Trend Log Multiple objects.

P. Runtime Logs. All controllers shall support logging and reporting of runtime for every binary object in the system.

1. Runtime data shall be sampled and stored in each individual BACnet® device using standard BACnet® objects and published properties. A workstation shall not be required for storage of custom runtime logs.

2. Runtime data shall include at a minimum total accumulated active time, total accumulated active transitions, active transitions today, timestamp and duration for each change of state for the previous 100 transitions.

Q. Workstation Connection. All controllers shall support a communications port for connection of a portable operator's terminal using a BACnet® physical data link.

R. Communicating Sensors. All controllers shall support and be capable of monitoring and controlling a network of communicating space sensors without consuming physical hardware input/output points on the device.

2.08 BUILDING LEVEL CONTROLLERS

A. Building Level Controllers. A dedicated building-level controller shall be provided for the execution of global strategies and for each large point-count major mechanical system and/or piece of equipment.

B. BACnet® Device Profile. All building level controllers shall comply with the minimum requirements of ANSI/ASHRAE Standard 135 Annex L for a BACnet® Building Controllers (B-BCs) and shall be certified and listed by the BACnet® Testing Laboratories (BTL) as a B-BC prior to the bid date for this project. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

C. BACnet® Networking. Building level controllers shall reside on the ELCN, BLCN or FLCN using the BACnet®/IP, BACnet®/Ethernet or MS/TP data links as specified in ANSI/ASHRAE Standard 135.

D. Communication. Building level controllers shall support the following communications requirements at a minimum:

1. Client and Server BACnet® Subscribe Change of Value (COV) Service.

2. Client and Server BACnet® Read Property Multiple (RPM) Service.

3. BACnet® transmit and receive frame segmentation.

4. Post-installation, field-configurable maximum information frames, APDU frame timeout, APDU segment timeout and APDU retries.

E. Alarm Annunciation. Building level controllers shall support SMTP and provide stand-alone remote annunciation of alarms via e-mail without additional hardware, B-OWS, B-AWS or web-server.

2.09 BUILDING LEVEL EQUIPMENT CONTROLLERS

A. Building-level equipment controllers shall be provided as required to achieve the performance prescribed in this specification for the execution of indoor environmental quality control and monitoring strategies through the control of mechanical systems or pieces of equipment as designated.

B. BACnet Device Profile. Building-level equipment controllers shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2012 Revision 14 Annex L a minimum of 30 days prior to the bid date for this project as follows:

1. BACnet Building Controller (B-BC)

C. BACnet Networking. Building-level equipment controllers shall natively support the following BACnet data links as specified in ANSI/ASHRAE Standard 135 and in compliance with the following physical layer standards at a minimum.

1. BACnet/IP: ANSI/ASHRAE Standard 135 Annex J.
2. ISO 8802.3 Ethernet (10/100 BaseT),
3. ISO 8802.3af PoE (10/100 BaseT), or
4. ISO 8802.3b/g/n Wi-Fi.
5. ISO 8802-3 (Ethernet): ANSI/ASHRAE Standard 135.7.
6. ISO 8802.3 Ethernet (10/100 BaseT),
7. ISO 8802.3af PoE (10/100 BaseT), or
8. ISO 8802.3b/g/n Wi-Fi.
9. Master Slave Token Passing (MS/TP): ANSI/ASHRAE Standard 135.9.
10. EIA-485.

D. Modbus Networking. Building-level equipment controllers shall natively support the following Modbus data links in compliance with the following physical layer standards at a minimum:

1. Modbus/TCP as a Master or Slave.
2. ISO 8802.3 Ethernet (10/100 BaseT),
3. ISO 8802.3af PoE (10/100 BaseT), or
4. ISO 8802.3b/g/n Wi-Fi.
5. Modbus/RTU as a Master or Slave.

6. EIA-485.

E. Power & Noise. In addition to the power and noise requirements for all controllers, building-level equipment controllers shall also support the following physical power link:

1. ISO 8802.3af PoE.

F. Universal Inputs. Building-level equipment controllers shall be provided with a minimum of six (6) software-selectable universal inputs dedicated for the connection of field devices compliant with the requirements for all controllers.

1. The total number of universal inputs connected to the building-level equipment controller shall be capable of being increased to a minimum of 18.

G. Integral Sensors. In addition to universal inputs dedicated for the connection of field devices, building-level equipment controllers shall support the following integral sensors at a minimum:

1. Temperature.

2. Resolution: ± 0.1 °C (0.18 °F).

3. Accuracy: ± 0.1 °C (0.18 °F).

4. Relative Humidity.

5. Range: 10-90 %RH.

6. Resolution: ± 0.1 %RH.

7. Accuracy: ± 3 %RH.

8. CO2.

9. Range: 400-2000 ppm.

10. Accuracy: ± 35 ppm.

11. Non-Linearity: < 1% of full scale.

12. Technology: Non-Dispersive Infrared Optical Sensor.

13. Occupancy.

14. Range: 5 m (16.4’).

15. Angle: 100° horizontal/82° vertical.

16. Technology: Passive Infrared Radiation (PIR).

17. All integral sensors shall comply with the System performance criteria detailed elsewhere in this specification.

H. Outputs. Building-level equipment controllers shall be provided with a minimum of six (6) jumper-selectable physical outputs dedicated for the connection of field devices. In addition to the requirements for universal outputs on all controllers, building-level equipment controllers shall also support at a minimum the following physical characteristics:

1. Solid state relay (500 mA @ 24 VAC/VDC).

2. The act of switching must not produce an audible noise discernable to the occupants of the space where the device is installed.

3. The total number of physical outputs connected to the building-level equipment controller shall be capable of being increased to a minimum of 16.

2.10 BUILDING-LEVEL OPERATOR DISPLAYS

A. Building-level operator displays shall be provided as required to complement building-level equipment controllers with a comprehensive local interface for the System.

1. Building-level operator displays shall be required to comply with all the requirements for building-level equipment controllers in addition to those prescribed in this specification clause.

B. BACnet. All building-level operator displays shall be certified and Listed by the BACnet Testing Laboratories (BTL) in compliance with the minimum requirements of ANSI/ASHRAE Standard 135-2012 Revision 14 Annex L prior to the bid date for this project as follows:

1. BACnet Building Controller (B-BC), and

2. BACnet Operator Display (B-OD).

2.11 FIELD-LEVEL EQUIPMENT CONTROLLERS

A. BACnet® Field Level Equipment Controllers. One (1) dedicated field-level equipment controller shall be provided for the execution of global and local strategies for each mechanical system and/or building system piece of equipment.

1. Distributed control of one piece of mechanical equipment shall not be performed by multiple DDC controllers.

2. Multiple pieces of mechanical equipment comprising one mechanical system may be controlled by a single DDC controller provided that all of the points associated with the equipment are hosted by the controller.

3. Any application exceeding eight (8) inputs or eight (8) outputs shall not be considered a terminal unit application and shall require a dedicated field-level equipment controller or a building-level controller.

4. All field-level equipment controllers provided shall be the same controller model and manufacturer.

B. BACnet® Device Profile. All field-level equipment controllers shall comply with the minimum requirements of ANSI/ASHRAE Standard 135 Annex L for a BACnet® Building Controllers (B-BCs) prior to the bid date for this project. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

C. BACnet® Networking. Field-level equipment shall reside on the BACnet® MS/TP data link as specified in ANSI/ASHRAE Standard 135.

D. BACnet® MS/TP Slave Device Support. Field-level equipment controllers shall be capable of automatically discovering BACnet® slave devices and shall be capable of serving as a proxy for BACnet® slave devices.

E. Communication. Field-level equipment controllers shall support the following communications requirements at a minimum:

1. Client and Server BACnet® Subscribe Change of Value (COV) Service.

2. Client and Server BACnet® Read Property Multiple (RPM) Service.

3. BACnet® transmit and receive frame segmentation.

4. Post-installation, field-configurable maximum information frames, APDU frame timeout, APDU segment timeout and APDU retries.

2.12 TERMINAL UNIT CONTROLLERS

A. Terminal Unit Controllers. One (1) dedicated terminal controller shall be provided for the execution of local strategies and for each mechanical terminal unit.

1. Any application with fewer than eight (8) inputs and eight (8) outputs may be considered a terminal unit application and shall require a dedicated terminal unit controller.

2. All terminal units with a common application shall be provided with the same unitary controller model and manufacturer.

B. BACnet® Device Profile. All terminal unit controllers shall comply with the minimum requirements of ANSI/ASHRAE Standard 135 Annex L for a BACnet® Building Controllers (B-BCs) and shall be certified and listed by the BACnet® Testing Laboratories (BTL) as a B-BC prior to the bid date for this project. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

C. BACnet® Networking. Terminal unit controllers shall reside on the FLCN using the BACnet® MS/TP data link as specified in ANSI/ASHRAE Standard 135 in compliance with the following requirements at a minimum:

1. Automatically detect the baud of the MS/TP network and then configure the device's communication baud to match that of the MS/TP network.

2. Be capable of efficiently communicating at a baud of 76.8 Kbps under normal network operational conditions with all devices executing the specified sequences of operation at the specified performance criteria.

D. Communication. Terminal unit controllers shall support the following communications requirements at a minimum:

1. Client and Server BACnet® Subscribe Change of Value (COV) Service.

2. Client and Server BACnet® Read Property Multiple (RPM) Service.

3. BACnet® transmit and receive frame segmentation.

4. Post-installation, field-configurable maximum information frames, APDU frame timeout, APDU segment timeout and APDU retries.

2.13 SPACE MOUNTED TERMINAL UNIT CONTROLLERS

A. As required, one (1) dedicated space mounted terminal controller shall be provided for the execution of local indoor environmental control and monitoring strategies and for each mechanical terminal unit.

1. Space mounted terminal controllers shall be aesthetically pleasing and specifically designed for permanent installation in a finished, occupied space.

2. All terminal units with a common application shall be provided with the same unitary controller model and manufacturer.

3. For space mounted controllers, any unitary application with between four (4) and eight (8) inputs or between four (4) and eight (8) outputs shall be considered an advanced terminal unit application.

B. BACnet® Device Profile. All space mounted terminal controllers shall be certified and listed by the BACnet® Testing Laboratories (BTL) prior to the bid date for this project. BTL product listings are available from BACnet® International (http://www.bacnetinternational.net/btl/).

1. Advanced application space mounted terminal controllers shall comply with the minimum requirements of ANSI/ASHRAE Standard 135 Annex L for a BACnet® Advanced Application Controllers (B-AACs).

C. BACnet® Networking. Space mounted terminal controllers shall reside on the FLCN using the BACnet® MS/TP data link as specified in ANSI/ASHRAE Standard 135 in compliance with the following requirements at a minimum:

1. Be capable of efficiently communicating at a baud of 76.8 Kbps under normal network operational conditions with all devices executing the specified sequences of operation at the specified performance criteria.

2.14 COMMUNICATING SPACE SENSORS

A. Communicating Space Sensors. All controllers of the BAS as provided will support networked, communicating space sensors for monitoring of internal environmental conditions and low-level operator interface without consuming hardware inputs/outputs on the host DDC controller.

1. Communicating space sensors shall be aesthetically pleasing and specifically designed for permanent installation in a finished, occupied space.

2. All communicating space sensors shall be developed, manufactured and supported by the same manufacturer of the BAS components specified herein and provided by the BAS Contractor.

3. A minimum of four (4) communicating sensors shall be supported by each DDC controller.

4. Space mounted terminal unit controllers with fewer than four (4) inputs and four (4) outputs shall not be required to support communicating space sensors.

B. System Interface. Communicating space sensors shall be capable of providing access to the Internetwork for an operator workstation and/or portable operator terminal.

2.15 AUTOMATIC CONTROL DAMPERS

A. Automatic Control Dampers. All automatic control dampers provided as a part of this specification shall bear the SMACNA seal in compliance with the SMACNA Certified Ratings Programs.

B. Opposed Blade Style. Unless otherwise scheduled on the contract drawings, opposed blade dampers shall be as follows:

1. Opposed blade dampers shall be used for all mixing, volume throttling and discrete airflow control applications installed in outdoor, relief, exhaust, and/or supply air streams as well as all applications immediately upstream of critical equipment and all ducted outlets.

2. Blade edges shall be interlocked and blade seals shall be compressible at all contact points. Channel frames shall also be provided with jamb seals.

C. Parallel Blade Style. Unless otherwise scheduled on the contract drawings, parallel blade dampers shall be as follows:

1. Parallel blade dampers shall be used in two-position, mechanical ventilation and exhaust, combustion intake and exhaust applications as well as applications where the damper constitutes the primary source of total system pressure loss or where greater control is required at the upper end of the airstream volume operating range.

2. Parallel blade dampers may also be used for outdoor and return air mixing applications as scheduled and if arranged to direct the airstreams toward one another.

D. Sections. Individual damper sections shall not exceed 125 cm (48”) wide and 150 cm (60”) tall. Applications requiring larger dampers shall be achieved by combining single damper sections. One (1) actuator, at a minimum, shall be provided per section.

E. Frame. Damper frame construction shall be a minimum of 13 gauge galvanized steel channel or 3 mm (1/8”) extruded aluminum with reinforced corner bracing and continuously welded.

F. Blades. Damper blades shall not exceed 20 cm (8”) in width or 125 cm (48”) in length. Blades are required to be suitable for medium velocity performance of 10 m/s (2000 fpm) at a minimum.

1. Damper blades and baffles shall be fabricated of minimum 16 gauge steel with corrosion resistant galvanized finish or 2 mm (0.08”) extruded aluminum at 15 cm (6”) width.

2. Damper blades mounted vertically shall be supported by thrust bearings

3. Dampers shall have a minimum of four brakes running the entire length.

G. Seals. All damper blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. Blade seals shall provide for a maximum leakage rate of 50 L/s per m2 (10 cfm per ft2) at 1000 Pa (4 inwc) differential pressure. Provide air foil blades suitable for a wide-open face velocity of 7.5 m/s (1500 fpm).

1. Damper leakage shall be certified in accordance with SMACNA Standards.

H. Bearings. Damper shaft bearings shall be as recommended by manufacturer for application; nylon, cycoloy, oilite® style oil impregnated sintered bronze or better.

I. Shafts. Shafts shall be a minimum of 12 mm (1/2”) diameter and be welded or riveted to the blade.

J. Outdoor Suitability. All outdoor air and relief air damper components shall be suitable for applications operating in the temperature range of -40˚C (-40˚F) to 75˚C (167˚F). They shall be insulated, thermally broken blades with blade seals.

K. Linear Characterization. All Automatic Control Dampers in modulating applications shall be sized so as to achieve linear airflow characteristics.

L. Operating Linkages and Damper Accessories:

1. All operating linkages and/or damper accessories required for installation and application in accordance with specification design intent and manufacturer’s installation procedures shall be provided.

2. Operating linkages provided external to dampers (crank arms, connecting rods, shaft extensions, etc.) for transmitting motion from the actuator/operator to dampers shall be designed as to functionally operate a load equal to or in excess of 200% of the maximum required operating force for the damper.

3. Crank arms and connecting rods shall be adjustable. Linkages shall be brass, bronze, zinc-coated steel, or stainless steel.

4. Adjustments of crank arms shall control the position of the damper.

5. Use of Operating Linkages external to damper drive shaft shall neither delay nor impede operation of the damper in a manner of performance less than a direct-coupled damper actuator. Operating linkages shall not under any circumstances be permitted to flex, warp, shift etc. under normal operation of connected damper sections.

2.16 AUTOMATIC CONTROL VALVES

A. Automatic Control Valves. Control valves shall be two-way or three-way type for two-position or modulating service as required and/or scheduled. Unless otherwise indicated, all valves shall have a minimum range-ability of 50:1.

B. Body & Trim. Body and trim style and materials shall be in accordance with the manufacturer’s recommendations for design conditions and service shown in compliance with the following at a minimum:

1. Equal percentage ports for modulating service.

2. Valve bodies shall meet or exceed pressure and temperature class rating based upon design operating temperature and 150% design operating pressure. Unless otherwise specified or scheduled, minimum body rating for any valve is 125 psi and a maximum fluid temperature of 177˚C (350˚F).

3. Valves shall have stainless-steel stems and packing boxes with extended necks to clear the piping insulation.

4. Globe valves shall have replaceable seats.

C. Close-Off/Differential Pressure Rating. All valves shall be guaranteed to have not more than 1% leakage of design flow rate at the pump shut-off pressure. All valve actuators and trim shall be furnished to provide the following minimum close-off pressure ratings unless otherwise specified or scheduled:

1. Two-way water valves: 150% of total system (pump) head.

2. Three-way water valves: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head (whichever is greater).

3. Steam valves: 150% of operating (inlet) pressure.

D. Water Valves. Unless otherwise specified or scheduled, water valves shall follow the following criteria:

1. Two-position service: Line size.

2. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through the heat exchanger (coil, load, etc.), 50% of the pressure difference between the supply and return mains, or 35 kPa (5 psi) (whichever is greater).

3. Three-way modulating service: Pressure drop shall be equal to twice the pressure drop through the heat exchanger (coil, load, etc.), 35 kPa (5 psi) maximum.

4. Valves 15 mm (1/2”) through 50 mm (2”) shall be bronze or cast brass body ANSI Class 250, spring-loaded, PTFE packing quick opening for two-position service.

5. Valves larger than 80 mm (2 ½”) shall be cast iron ANSI Class 125 with guided plug and PTFE packing.

6. Valves 15 mm (1/2”) through 50 mm (2”) shall be ANSI/ASME B1.20.1 (NPT) threaded connections.

7. Valves 65 mm (2 ½”) to 80 mm (3”) shall use flanged connections.

E. Control Ball Valves. Where scheduled, control ball valves shall comply with the following:

1. All control ball valves shall be furnished with chrome plated bronze ball and stainless steel stem with fiberglass reinforced Teflon® seats and seals. The valves shall have a blowout proof stem design.

2. The stem packing shall be 2 O-rings designed for modulating service and requiring no maintenance.

3. All control ball valves shall feature characterized flow guides when used for modulating applications.

F. Butterfly Valves: Where scheduled, butterfly valves shall comply with the following:

1. Unless otherwise scheduled, butterfly valves shall have a minimum range ability of 10:1.

2. Bodies for 80 mm (3”) to 300 mm (12”) valves shall be fully-lugged cast iron. Bodies for larger valves shall be as scheduled.

3. Flanges shall meet the requirements of ANSI Standard 125 and ANSI Standard 150.

4. The stem shall be one-piece, stainless steel and designed as to accommodate 50 mm (2”) of insulation.

5. The shaft shall be 316 stainless steel and supported at a minimum of three (3) locations with PTFE bushings for positive alignment.

6. The seat shall be EPDM; phenolic backed, non-collapsible and easily replaceable.

7. The disc shall be aluminum bronze to provide bubble-tight close-off in either direction.

G. Chilled Water Valves. Unless otherwise scheduled or required by the manufacturer valves for chilled water and/or glycol service shall adhere to the following:

1. All internal trim regardless of body style shall be Type 316 stainless steel.

2. Valves larger than 80 mm (3”) shall use butterfly valves

2.17 AUTOMATIC CONTROL ACTUATORS

A. Electric Actuation. Unless otherwise specified or scheduled, all control actuators shall be electric/electronic direct-coupled type. Actuators shall have a means for reversing drive direction and a manual override.

1. The actuator shall have electronic overload or stall protection to prevent damage to the actuator throughout rotation. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.

B. Sound level shall not exceed 45 dB for high torque nor 35 dB for VAV actuators.

C. Spring Return. Where shown, for power-failure or safety applications, an internal mechanical spring-return mechanism shall be built-in to the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.

1. All mechanical equipment with direct introduction of outside air shall require fail-safe spring return actuators.

2. Terminal equipment without direct introduction of outside air are permitted to have actuators that maintain their last commanded position when power is lost to the actuator.

D. Clutch/Gear Release. All non-spring return actuators shall have an external manual clutch/gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 7 Nm (60 in-LB) torque capacity shall have a manual crank for this purpose.

E. Modulating Actuators. Unless otherwise specified or scheduled, all modulating actuators shall be positive positioning and accept a 0 to 10 VDC or 0 to 20 mA control signal and provide an operating range of 2-10 VDC or 4-20 mA.

F. Position Feedback. All actuators shall feature a visual position feedback indicator. All non-terminal unit actuators shall provide a VDC or mA feedback signal proportional to actuator position.

G. Power. All 24 VAC/VDC actuators shall operate in Class 2 circuits.

H. Enclosure. Actuator casing and/or enclosures shall be appropriate to the application.

1. Actuators used in or near outdoor air streams shall have NEMA 2 (IEC IP21) housings.

2. Actuators exposed to moisture, in wet mechanical rooms or located outdoors shall be meet NEMA 4X (IEC IP66) requirements or as directed by the AHJ.

2.18 TEMPERATURE DEVICES

A. Analog Temperature Sensors. Analog temperature sensors shall be precision element thermistor type.

B. Duct Sensors. Duct temperature sensors shall include junction box for wiring connections and gasket to prevent air leakage and vibration noise.

1. Single point duct temperature sensor probe shall consist of 316 stainless steel extending to the center of the duct.

2. Averaging duct temperature sensor for outdoor air mixing sections shall consist of a Teflon coated, copper, or stainless steel series/parallel averaging sensor element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Averaging sensors shall be a minimum of 1.5 m (5’) in length per 1 m2 (10 ft2) of duct cross sectional area.

C. Immersion Sensors. Liquid immersion temperature sensor shall be provided with a separable stainless steel well, sensor and connection head for wiring connections. The well must be designed to be consistent and appropriate with the system operating pressure and velocity.

D. Space Sensors. Space temperature sensor shall consist of an element within a ventilated cover aesthetically pleasing and specifically designed for permanent installation in a finished, occupied space.

1. In private and semi-private spaces that serve full-time or full-time-equivalent occupants including but not limited to offices, work rooms, meeting rooms, conference rooms, etc., space sensors shall be provided with set-point adjustment and occupancy bypass. Bypass not required in zones with occupancy sensors or applications that are constantly occupied.

2. In public spaces without full-time or full-time-equivalent occupants including but not limited to lobbies, hallways, atriums, break rooms, cafeterias, restrooms, theaters, gymnasiums, mechanical spaces, plenums, etc., simple temperature sensor without set-point or bypass shall be provided.

3. Sensors with operator interface keypads and displays shall be provided as indicated or scheduled elsewhere.

E. Outdoor Air Temperature. Outdoor air temperature sensor shall consist of a single device sensor, ventilated non-metallic sun shield, utility box for terminations, and watertight gasket to prevent water seepage.

F. Differential Temperature. Provide matched sensors for differential temperature applications.

G. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL-Listed, vapor pressure type, with an element of 6 m (20') minimum length.

1. Provide one (1) low-limit thermostat for each 2 m2 (20 ft2) of coil face. Low-limit thermostat shall be installed such that for every ft2 of coil face shall be covered by at least 12" of low-limit thermostat element.

2. Low-limit thermostat shall respond to the lowest temperature sensed in by any 30 cm (12") section of the element.

3. Low-limit thermostats shall be manual-reset, DPDT-style with a minimum of one (1) normally-open contact and one (1) normally-closed contact.

H. High-Limit Thermostats. High-limit airstream thermostats shall be UL-Listed, bimetal-operated, manual reset type.

I. Low-voltage Thermostats. Low-voltage thermostats shall be 24 VAC, bimetal-operated or electronic type with adjustable of fixed anticipation heater, concealed set-point adjustment 13˚C to 30˚C (55˚F to 85˚F) set-point range, 1˚C (2˚F) maximum differential and vented ABS plastic housing.

J. Line-voltage Thermostat. Line-voltage thermostats shall be UL-Listed bi-metal actuated, open contact type, enclosed, snap-switch type or equivalent solid-state type with adjustable of fixed anticipation heater, concealed set-point adjustment 13˚C to 30˚C (55˚F to 85˚F) set-point range, 1˚C (2˚F) maximum differential and vented ABS plastic housing.

K. Thermostat guards shall be provided where specified, indicated on control diagram, or indicated on floor plans. Guards shall be firmly attached to wall and thermostat cover shall be visible through guard. Covers shall be clear Lexan. Opaque covers shall be provided where specified.

L. Sensor accuracy and repeatability shall be as described in Table 1 and Table 2 in Part 1 GENERAL, 1.07 SYSTEM PERFORMANCE, paragraph K.

2.19 CARBON MONOXIDE (CO) SENSORS

A. Carbon monoxide (CO) sensors shall have a linear voltage (0-5 VDC, 1-5 VDC, 0-10 VDC, 2-10 VDC) or current (4-20 mA) output.

B. Carbon monoxide (CO) sensors shall be totally sealed, electro-chemical sensor with audible and visual alarms, adjustable set-point, audible alarm reset, remote alarm and warning relays, tamper resistant case. Warning and alarm level set-points shall be set as recommended by the manufacturer.

1. Output ranges shall be selectable between 0-200 ppm and 0-1000ppm.
2. Alarm relay setting selectable at 100 ppm or 0-1000ppm.
3. Audible exposure alarm 85 dB Piezo transducer.
4. Response time shall be less than 15 seconds.
5. Sensor shall be a UL2034 Recognized Component.
6. Drift shall be less than +/- 5% per year.
7. Ambient operating conditions shall be 0 – 100 ºF; 15 – 95 %RH.

C. Sensor accuracy and repeatability shall be as described in Table 1 and Table 2 in Part 1 GENERAL, 1.07 SYSTEM PERFORMANCE, paragraph K.

D. Provide a gas calibrator kit complete with two cylinders of calibration gas, gas delivery system, flow regulation system, flow meter, pressure gauge, and connector hose. Cylinders with gas should be prepared and labeled in accordance with Federal (DOT) Regulation 39.

2.20 CARBON DIOXIDE (CO2) SENSORS

A. Carbon dioxide (CO2) sensors shall have a linear voltage (0-5 VDC, 1-5 VDC, 0-10 VDC, 2-10 VDC) or current (4-20 mA) output.

1. Output ranges shall be selectable between 0-2000 ppm and 0-5000ppm.
2. Response time shall be 60 seconds to 90% of reading or better..
3. Sensor shall be a UL2034 Recognized Component.
4. Drift shall be less than +/- 5% per year.
5. Ambient operating conditions shall be 0 – 100 ºF; 15 – 95 %RH.

B. Carbon dioxide (CO2) sensors shall be Non-dispersive Infrared (NDIR) type with relay output.

C. Room carbon dioxide (CO2) sensors shall be enclosed in an ABS plastic case aesthetically compatible with space finishes.

D. Duct carbon dioxide (CO2) sensors shall be enclosed in an ABS polycarbonate case suitable for duct mounting.

2.21 HUMIDITY DEVICES

A. Humidity transducers shall have a linear voltage (0-5 VDC, 1-5 VDC, 0-10 VDC, 2-10 VDC) or current (4-20 mA) output with field adjustable zero and span.

B. Duct Sensors. Duct-mounted humidity sensors shall have a sensing range of 20% to 80% RH and shall be provided with a sampling chamber.

C. Space Sensors. Space sensors shall have a sensing range of 20% to 90% RH.

D. Outdoor Air Sensors. Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH and shall be suitable for ambient conditions of -40˚C to 75˚C (-40˚F to 170˚F).

E. Drift. Sensor drift shall not exceed 1% of full scale per year.

F. Humidistats

1. Humidistats shall have SPST snap-acting contacts. The humidistat shall have an adjustable minimum differential of 4 %RH. Contacts shall open on rise in sensed humidity and close on a drop.

G. High Limit Humidity Controller

1. High Limit Humidity Controller shall be duct mounted with an air sampling tube for sampling humidity within the duct.

2. Set-point range shall be 65% to 95% RH in 5% increments. Operable up to 125 ºF.

2.22 PRESSURE DEVICES

A. Pressure Transducers.

1. Pressure transducers shall have a linear voltage (0-5 VDC, 1-5 VDC, 0-10 VDC, 2-10 VDC) or current (4-20 mA) output with field adjustable zero and span.

2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.

B. Water Pressure Transducers. Water pressure transducers shall utilize MEMS technology with built-in snubbers. Differential water pressure transducers shall not require the five-valve manifold for isolation, bypass and bleed.

1. Water pressure transducers shall have over-range protection of at least 2X the rated pressure.

2. Water pressure transducers shall have switch selectable outputs of 2-wire 4-20mA, 3-wirw 0-5Vdc or 0-10 Vdc.

3. Differential water pressure transducers shall consist of two (2) separate pressure sensors terminated, via factory fabricated cabling, to a separate transmitter with LCD display that displays supply, return and differential pressures.

C. Differential Pressure Switches

1. Switch contacts shall be snap action micro-switch type Form C contact.

2. Assembly shall operate automatically and reset automatically when conditions return to normal. Complete sensor assembly shall be protected against vibration and movement.

3. High pressure cutout switches shall be manual reset devices.

4. Switches shall be vented to withstand a 50% over-pressure without loss of calibration.

D. Flow Proving Switches

1. Flow proving switches provided as a part of this specification shall be differential pressure type UL-Listed , SPDT snap-acting, pilot-duty rated (125 VA minimum), NEMA 2 enclosure, with scale range and differential suitable for intended application or as specified.

2.23 AIRFLOW MONITORING STATIONS (AFMS)

A. General

B. Airflow measurement stations shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.

1. Thermal dispersion devices that indirectly heat a thermistor are not acceptable.

C. Provide one AFMS for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature at each measurement location.

D. Substitution requests for acceptance less than 10 days prior to bid date or products submitted in non-conformance with the requirements of this specification will not be considered.

E. Each AFMS shall be provided with a microprocessor-based transmitter and one or more sensor probes.

1. Devices that have electronic signal processing components on or in the sensor probe are not acceptable.

F. Airflow measurement shall be field configurable to determine the average Actual or Standard mass airflow rate.

1. Actual airflow rate calculations shall have the capability of being corrected by the transmitter for altitudes other than sea level.

G. Temperature measurement shall be field configurable with velocity weighted average as the default, or manual selection of arithmetic average temperature.

H. Sensor Probes

I. Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube, 316 stainless steel tube are available when required.

J. Sensor probe mounting brackets shall be constructed of 304 stainless steel.

K. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.

1. PVC jacketed internal wiring is not acceptable.

2. Probe internal wiring connections shall consist of solder joints and spot welds.

3. Internal wiring connections shall be sealed and protected from the elements. They shall be capable of direct exposure to water without affecting instrument operation.

4. Connectors of any type within the probe are not acceptable.

5. Printed circuit boards within the probe are not acceptable.

6. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67° F to 392° F (-55° C to 200° C) and continuous and direct UV exposure.

7. Plenum rated PVC jacket cables are not acceptable.

8. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.

9. Each sensor probe shall contain one or more independently wired sensing nodes.

10. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter in the field.

11. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene.

12. Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.

13. Devices with exposed leads are not acceptable.

14. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.

15. Each sensor node shall be individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard and have an accuracy of ±2% of reading over the entire calibrated airflow range of 0 to 5,000 FPM (25.4 m/s).

16. Upon request the manufacture shall submit for AMD approval a copy of the NIST report of calibration used for the reference standard used.

    1) Devices claiming NIST traceability to third party laboratories and not directly to NIST are not acceptable

    2) Devices calibrated against standards other than the NIST LDA are not acceptable.

17. The number of independent sensor nodes provided shall be as per the manufacturers recommendation.

L. Transmitter

M. A remotely located microprocessor-based transmitter shall be provided for each measurement location.

N. The transmitter shall be comprised of a main circuit board and interchangeable interface card.

O. All printed circuit board interconnects, edge fingers, receptacle plug pins and PCB test points shall be gold plated.

P. All printed circuit boards shall be electrolysis nickel immersion gold (ENIG) plated.

Q. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.

R. The transmitter shall be capable of determining the airflow rate and temperature average of all connected sensor nodes in an array for a single location.

1. Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).

S. The transmitter shall be capable of providing a high and/or low airflow alarm with user-defined set point and % of set point tolerance. Alarm shall be capable of being manually or automatically reset and low-limit cutoff value may be selected to disable the alarm. An alarm delay function shall also be field defined.

T. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.

U. The transmitter shall be capable of field configuration, diagnostics and include Field Output Adjustment Wizard that allows for a one or two point field adjustment to factory calibration for installations that require adjustment.

V. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.

W. The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm), in combination with:

1. one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection, or

2. one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection.

3. The analog signal capability shall include two output terminals: the first (AO1), shall provide the total airflow rate and the second output (AO2) shall be field configurable to provide one of the following:

4. temperature

5. low and/or high airflow user-defined set point alarm, or

6. system status alarm

7. The transmitter shall also be available with a single isolated LonWorks Free Topology network interface. Transmitters shall be available alternatively with one USB connection for thumb-drive data logging of sensor data. Neither of these options shall include analog output signals.

8. The network communications RS-485 (BACnet MS/TP or Modbus RTU) or Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) shall provide: the average airflow rate, temperature, hi and/or low airflow set point alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures. Individual node airflow rates and temperatures shall NOT be available via the network with Lon.

9. The transmitter shall have an on-off power switch. Isolation transformers shall not be required.

10. The transmitter shall be powered by 24 VAC (22.8 to 26.4 under load) @20 V-A maximum and use a switching power supply that is over-current and over-voltage protected.

11. The transmitter shall use a “watchdog” timer circuit to ensure automatic reset after power disruption, transients and brown-outs.

12. Each transmitter shall have an operating temperature range of -20° F to 120° F (-28.9° C to 48.9° C) and humidity range of 5 to 95% RH.

13. All network-capable AMD models supplied with RS-485 interface and BACnet protocol shall be BTL Listed.

2.24 CURRENT DEVICES

A. AC Current Transmitters. AC current transmitters shall be UL-Listed self-powered, combination split-core current transformer type with two-wire voltage (0-5 VDC, 1-5 VDC, 0-10 VDC, 2-10 VDC) or current (4-20 mA) output.

1. Ranges shall include 10, 20, 50, 100, 150 and 200 Amp full-scale with internal zero and span adjustment and ±1% full-scale accuracy at 500 ohm maximum burden.

2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA certified.

B. Current Transformers. Current transformers shall be UL/CSA recognized, split-core and completely encased (except for terminals) in approved plastic material. Transformers shall be selected for ±1% accuracy at 5 A full-scale output.

C. Current Switches shall be UL-Listed self-powered, split-core or solid core type with fixed trip current, status LED and solid state contact output.

2.25 VOLTAGE DEVICES

A. Voltage Transmitters.

1. AC voltage transmitters shall be UL-Listed self-powered two-wire type with voltage (0-5 VDC, 1-5 VDC, 0-10 VDC, 2-10 VDC) or current (4-20 mA) output and with zero and span adjustment.

2. Ranges shall include 100-300 VAC, 200-250 VAC, 250-330 VAC and 400-600 VAC full-scale, adjustable with ±1% full-scale accuracy with 500 ohm maximum burden.

3. Transmitters shall be UL/CSA recognized at 600 VAC rating and meet or exceed the requirements of ANSI/ISA S50.1.

B. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized at 600 VAC rated, complete with built-in fuse protection and completely encased (except for terminals) in approved plastic material.

2. Transformers shall be suitable for 4˚C to 45˚C (40˚F to 130˚F) and shall provide ±0.5% full-scale accuracy at 24 VAC and a 5 VA load.

2.26 THERMAL ENERGY METERS

A. The meter shall communicate with the BAS via an RS-485 network utilizing the BACnet® MSTP protocol. Communications baud rates shall auto-configure to match site FLCN.

B. Thermal energy meters shall be provided as scheduled with matched thermistor temperature sensors with a differential temperature accuracy of ±0.1˚C (±0.15˚F) and a flow meter that is accurate within ±1% at calibrated normal flow rate and does not exceed ±2% of actual reading over an extended 50:1 turndown range and compliant the following requirements:

1. Unit accuracy shall be ±1%, factory calibrated and traceable with NIST certification.

2. NEMA 1 enclosure.

3. Panel or remote mounted display.

4. Isolated voltage (0-5 VDC, 1-5 VDC, 0-10 VDC, 2-10 VDC) or current (4-20 mA) outputs for energy rate, supply and return temperature and flow.

C. Meter must include a five (5) year warranty.

2.27 ELECTRICAL ENERGY METERS

A. Electrical Energy Meter. Electrical energy meters shall be provided as scheduled and shall be equipped with a voltage transducer and micro-processor to digitally communicate with the meter. CTs shall be designed so as not to require shorting blocks. The meter shall communicate with the BAS via an RS-485 network utilizing the BACnet® MSTP protocol. Communications baud rates shall auto-configure to match site FLCN. Meter calibration shall occur at the CT/voltage transducers. The meter shall be self-configuring when CTs are attached. The meter and CTs shall comply with the following requirements:

1. The meter shall operate from a class 2 power supply: 12 – 30 Vdc or 24 Vac.

2. The metering system shall isolate line voltage connections within the electrical panel. The meter shall also provide a low voltage connection between the electrical panel and a separate control enclosure.

3. Unit Accuracy shall be ±1%, for V, A, kW, kVAR, kVA

4. Measured voltage ranges, 90 VACL-N through 600 VACL-L.

5. Measured voltage configurations, 1Ph, 2Ph, 3Ph Wye (4-Wire), 3Ph Delta (3-Wire). The meter shall be capable of measuring up to 3 single-phase independent loads, or a combination of single-phase and split-phase loads.

6. Measured frequency ranges, 45 to 65 Hz.

7. CT current ranges, 300 Amp through 6000 Amps

8. Ambient operating environment:

9. Temperature, -4 to 140 ºF (-20 to 60º C).

10. Humidity, 0 to 95% non-condensing

11. Current/Voltage transducer accuracy, ±1% of reading.

12. The meter shall be equipped with at least two local pulse inputs for connection to additional pulse meters (i.e. gas, water, etc.). These pulse inputs shall be capable of registering pulse widths as low as one (1) millisecond.

13. As a minimum the meter shall provide the following per phase measurements:

14. Instantaneous voltage, current, current angle, power factor.

15. Instantaneous power (real, reactive, apparent)

16. Accumulated energy (real, reactive, apparent)

17. As a minimum the meter shall provide the following overall power system measurements:

18. Frequency

19. Average phase voltage, current, power factor

20. Phase-to-phase angle (voltage)

21. Instantaneous Power (real, reactive, apparent)

22. Accumulated energy (real, reactive, apparent).

B. Meter shall measure average power over a configurable interval (demand power)

C. Meter shall store maintain accumulated energy measurements in non-volatile memory.

D. Meter shall be UL 916 listed.

E. Meter must include a five (5) year warranty.

2.28 RELAYS

A. Control relays shall be UL-Listed, enclosed with LED energized indicator. Contact rating, configuration and coil voltage shall be suitable for application. Coil current shall be less than 50 mA.

2.29 TEMPERATURE CONTROL PANELS

A. Temperature Control Panels. Provide pedestal base or wall mounted local control enclosures to be fully enclosed NEMA 1 (IEC IP20) at a minimum with hinged door, key-lock latch and removable subpanels to house all control components appropriate to the environment, service, and/or as required by the code enforcing authorities and other AHJ.

1. All enclosures shall be UL-Listed.

2. Enclosures in mechanical rooms shall meet NEMA 2 (IEC IP21) requirements at a minimum or as directed by the AHJ.

3. Enclosures in all locations not requiring NEMA 2 (IEC IP21) including occupied spaces, above ceilings and plenums shall be the same NEMA (IEC) classification as other enclosures located in the same environment, except if location requires additional protection due to potential vandalism or environmental conditions or as directed by the AHJ.

4. Enclosures exposed to moisture, in wet mechanical rooms or located outdoors shall be meet NEMA 4X (IEC IP66) requirements or as directed by the AHJ.

5. Unless otherwise required by local codes and/or AHJ, all enclosures shall be a minimum of 16 gauge steel or aluminum, totally enclosed on all sides and powder coated or painted with a baked enamel finish.

2.30 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies & Control Transformers. Control transformers and power supplies shall be UL-Listed. Provide Class 2 current-limiting type or over-current protection in both primary and secondary circuits for Class 2 service not to exceed 100 VA in accordance with the applicable following requirements or as directed by the AHJ.

1. NEC 2011 (NFPA 70) Chapter 7 Article 725 – Class 1, Class 2 and Class 3 Remote-Control, Signaling and Power-Limited Circuits.

2. NEC 2011 (NFPA 70) Chapter 9 Table 11(A) and Table 11(B).

3. Canadian Electrical Code, Part 1 (CSA C22.1-12) Rule 16-200.

B. DC Power Supplies. DC power supply output shall match output current and voltage requirements. Power supply shall be half-wave rectified type with the following minimum specifications:

1. Output ripple: 5.0 mV maximum peak-to-peak.

2. Regulation: 1.0% line and load combined.

3. Response: 100 ms for 50% load changes.

4. Built-in overvoltage and overcurrent protection and able to withstand a 150% current overload for a minimum of three (3) seconds without tripping or failure.

C. Power Line Filtering. Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component.

2.31 INTERCONNECTING WIRING AND RACEWAYS

A. Wiring & Cable. All wiring regardless of service and/or voltage shall comply with the Contract Document Electrical System Specifications, the National Electric Code (NEC), CSA C22.1-12 and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ).

B. All insulated wire to be copper conductors, UL labeled for 90 ˚C minimum service.

END OF PART 2

PART 3 - EXECUTION

3.01 GENERAL PROJECT REQUIREMENTS

A. The System, all its components, execution, and compliance with this specification is the responsibility of the BAS Contractor.

1. Unless specified otherwise, all System devices and components as required to appropriately satisfy the intent of the specified Sequence of Operations, the requirements of the contract drawings and of this specification shall be provided as a part of this section.

2. All control system components shall be installed in locations as required to properly sense the controlled medium and perform per the intent of the specified Sequence of Operations, the requirements of the contract drawings and of this specification.

B. Statement of Compliance. The System Contractor must submit a Statement of Compliance to the Owner, Owner's Agent, and/or Contract Officer that details compliance with the specification requirements in a spreadsheet format.

1. The Statement of Compliance must be received by the Owner, Owner's Agent, and/or Contract Officer a minimum of fourteen (14) days prior to the bid/tender date; and must be received prior to submitting any proposals or pricing.

2. The Statement of Compliance must detail each DDC component including at a minimum all controllers, communicating sensors, network components, software, server and workstation hardware, as well as any other components to be provided as a part of this specification as directed by the Owner, Owner's Agent, Contract Officer, and/or Engineer.

3. For each DDC component, the individual model/type and version to be provided under this specification must be represented in the Statement of Compliance complete with Specification clause, Tag, Manufacturer, Make, Model, Version, and Quantity.

4. For any DDC component that complies with all specification requirements, a single line may be entered in the Statement of Compliance indicating simply "Complies with all requirements as specified". If all DDC components comply with all specification requirements, a signed statement on company letterhead may be submitted indicating that "All components comply with all requirements as specified".

5. For any component that does not comply with all specification requirements, each specification clause applicable to the component must be listed in the Statement of Compliance and for each clause the contractor must indicate either "Comply" or "Does Not Comply".

6. If, after having submitted a Statement of Compliance indicating that a DDC component is in-compliance with the requirements of the specification, the component is found to be non-compliant, it shall be the responsibility of the Contractor to replace the component at no additional charge with a compliant component at the discretion of the Owner, Owner's Agent, Contract Officer, and/or Engineer.

7. If a DDC component is omitted from the Statement of Compliance and is found to be non-compliant, it shall be the responsibility of the Contractor to replace the component at no additional charge with a compliant component at the discretion of the Owner, Owner's Agent, Contract Officer, and/or Engineer.

8. If a Statement of Compliance is not submitted, it shall be the responsibility of the Contractor to replace any non-compliant component at no additional charge with a compliant component at the discretion of the Owner, Owner's Agent, Contract Officer, and/or Engineer.

C. Ownership. All hardware, databases, programming, and data provided by and/or resultant from the System provided under this specification shall become the exclusive property of the Owner.

D. BACnet Virtual Private Network (B/VPN). All BACnet internetwork communication between separate broadcast domains shall be required to be secured using a BACnet Virtual Private Network (B/VPN).

E. Workstation. Provide one (1) BACnet Advanced Operator Workstation or one (1) Embedded Operator Workstation per building as outlined in this specification and as directed by the Owner.

F. HVAC Graphical Component Library. A library of standard HVAC graphical image components consistent with the delivered graphical user interface shall be provided.

1. The library of standard HVAC graphical image components shall allow the Owner to create custom graphics consistent with the delivered graphical user interface using standard image file formats and the drawing or graphical development application of choice.

1. The library of standard HVAC graphical image components provided to the Owner shall not require the use of any proprietary or specific graphics development application.

2. The library of standard HVAC graphical image components provided shall include all the equipment and standard symbols used in the graphical user interface delivered as a part of the System.

3. The library must include professionally rendered three-dimensional (3D) static and animated images.

   a. The library shall be provided complete with representations of mechanical equipment (e.g., AHUs, chillers, boilers, etc.), mechanical components (e.g., pumps, fans, coils, compressors, dampers, sensors, etc.) and interconnecting ductwork, piping, etc.

2. All graphical image components provided shall be available at the same perspective allowing for individual components to interlock for the construction of custom equipment, systems and piping schemes.

3. The library shall be provided to include isometric piping components in colors compliant with the ANSI/ASME A13.1 standard for pipe and valve marking for the construction of custom piping systems consistent with the physical orientation and configuration.

4. For the duration of the warranty period, the System Contractor shall make available to the Owner, upon request, custom components not included in the library of standard HVAC graphical components as required to represent equipment included in this Contract.

    a. Giving the Owner access to a graphical image library or service that develops custom components on request is an acceptable alternative to Contractor-developed components.

G. Mobile Device App. The System shall be delivered complete with a mobile device app for an untethered mobile operator interface.

H. Archive Server. Provide BACnet Data Archive Server with sufficient capacity for archival of critical system-level objects at 96 samples per day for the duration of the warranty period.

I. Server/Hardware Platform. Utilize existing WWCSD Desigo CC Server.

J. Terminal Unit Space Sensors. Provide one (1) communicating space sensor with temperature, set-point, occupancy bypass, keypad and digital display for each terminal unit.

K. SNTP Time Synchronization. The system time of all BACnet devices on the internetwork must be automatically synchronized using SNTP.

1. The System shall be automatically synchronized with a Simple Network Time Protocol (SNTP) server (e.g., us.pool.ntp.org, ca.pool.ntp.org, etc.).

2. The System shall automatically synchronize controller clocks from a designated Time Master at a minimum of once per hour via the internetwork.

L. Training. Provide on-site or classroom training sessions throughout the contract period for personnel designated by the Owner as noted above in paragraph 1.10.

3.02 COORDINATION

A. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades and equipment manufacturers to ensure a fully functioning and complete BAS.

B. All automatic control dampers, control valves, separable sockets, flow switches, flow sensors, and other in line pipe devices, furnished by the BAS Contractor shall be installed by the HVAC Contractor under the BAS Contractor's supervision. All blank off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the HVAC Contractor. BAS Contractor shall install all actuators, transmitters, and transducers associated with the flow control/sensing equipment.

C. The demarcation of work and responsibilities between the BAS Contractor and other related trades shall be as outlined in the Responsibility Matrix herein. This matrix is not intended to relieve the BAS Contractor of the obligation to assure the complete execution of any work for which responsibility is assigned to the BAS Contractor, when the BAS Contractor is a sub-contractor to the HVAC Contractor.

D. The matrix key is as follows:

1. 25 BAS Contractor

2. 22 Plumbing Contractor

3. 23 HVAC Contractor

4. 26 Electrical Contractor

5. EP Power for the device controls is provided by means internal to the device. Control power is provided from the power circuit to the device, which is the responsibility of the Electrical Contractor.

6. Wiring Note: Power wiring by "BAS" indicates that the BAS Contractor is responsible for extending power from a junction box or source, which has been provided by the Electrical Contractor, to a device or through a transformer to low voltage system. Transformer is to be provided by the BAS Contractor.

RESPONSIBILITY MATRIX

	WORK	Furnished By:	Installed By:	Low Voltage Wiring By:	Power Wiring By:
1.	Control valves	25	23	25	N/A
2.	Control dampers	25	23	25	N/A
3.	Duct mounted sensors	25	23	25	N/A
4.	Hydronic sensors	25	23	25	N/A
5.	Electrical energy meters	25	26	25	N/A
6.	Gas energy meters	25	22	25	N/A
7.	Water energy meters	25	22	25	N/A
8.	Duct smoke detectors	23	23	25	26
9.	Smoke and fire/smoke dampers	23	23	25	26

E. Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the BAS Contractor shall assist in coordinating space requirements.

F. Coordinate and schedule work with all other trades in the same area, or with work that is dependent upon other trades to facilitate mutual progress. Report all conflicts and anticipated delays to the project construction management team for resolution immediately upon identification.

G. Life Safety.

H. Duct smoke detectors required for air handling unit shut down are furnished under another division of this specification. The BAS Contractor shall interlock smoke detectors to air handling units for shut down as described in the Sequences of Operation.

I. Smoke dampers and actuators required for duct smoke isolation are provided under another division of this specification. The BAS Contractor shall interlock smoke dampers to air handling units if required and as described in the Sequences of Operations.

J. Other sections and/or divisions of this specification include controls and control devices that are to be a part of or interfaced to the BAS specified in this section. These devices shall be integrated into the BAS and coordinated by the BAS Contractor as follows:

K. All communication and network media and equipment integrated with the BAS provided by any Contractor or Vendor shall comply with the requirements of this specification.

L. The Contractor/Supplier furnishing and/or providing any controls products to be integrated to the BAS are responsible for the configuration, programming, start-up, testing, and proof-of-performance of that product to meet the requirements of the Sequences of Operation.

M. The BAS Contractor shall coordinate resolution of incompatibilities that arise between the control products provided as a part of this section and products provided as a part of other sections or divisions of the specification.

3.03 GENERAL WORKMANSHIP

A. BAS installation shall be performed by professionals in a workmanlike manner consistent with acceptable industry standards for performance and in compliance with the contract documents, Project Electrical System Specifications, the National Electric Code (NEC), CSA C22.1-12 and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ) and in compliance with the following at a minimum:

B. Installation of all DDC devices, enclosures, wiring, equipment, control devices and sensors shall be installed in accordance with the manufacturers' recommended installation procedures and as specified.

C. All control devices are to be provided and installed with all required gaskets, seals, flanges, connection enclosures, thermal compounds, insulation, piping, fittings and valves as required for design operation, isolation, equalization, purging and calibration.

D. Install all equipment as to be readily accessible as defined by Chapter 1, Article 100, Part A of the National Electric Code (NEC) or CSA C22.1-12 Rule 2 (as applicable) and/or local codes and standards whichever is more stringent and such that it provides sufficient clearance for system maintenance, component service, calibration, removal, repair or replacement.

E. Install all equipment, piping, and wiring/raceway parallel to building lines.

F. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

G. All control devices mounted outdoors shall be protected by a weather-shield, integral outdoor enclosure, etc. and from ambient elements in such a manner as to not impede design functionality and/or sensing.

H. Dielectric isolation shall be provided where dissimilar metals are used in installation for connection and support.

I. Penetrations through and mounting holes in the building exterior associated with the BAS installation shall be sealed and made water-tight.

3.04 FIELD QUALITY CONTROL

A. BAS Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

B. BAS Contractor shall have all work inspected as required by local and/or regional code enforcing authorities and/or AHJ.

3.05 WIRING

A. BAS control wiring shall be performed by professionals in a workmanlike manner consistent with acceptable industry standards for performance and in compliance with the contract documents, Project Electrical System Specifications, the National Electric Code (NEC), CSA C22.1-12 and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ). When non-code compliance requirements of the Electrical System Specifications and this specification section differ, this section shall take precedence.

B. Unless otherwise specified it shall be the responsibility of the BAS Contractor to provide all of the wiring necessary to provide a complete BAS in compliance with the requirements of this specification.

C. All wiring consistent with the definitions of NEC/CSA Class 1 (line voltage) shall be installed in UL-Listed raceway or conduit according to the requirements of the NEC, CSA C22.1-12, the Electrical System Specifications and any/all applicable local codes and/or AHJ.

D. All wiring consistent with the definitions of NEC/CSA Class 2 (low voltage) control wiring shall be sub-fused as required and installed according to the requirements of the NEC, CSA C22.1-12, the Electrical System Specifications and any/all applicable local codes and/or AHJ.

E. Class 2 wiring concealed in accessible locations not installed in UL-Listed raceways or conduit may be used provided that the cable is UL-Listed for the intended application.

F. When Class 2 wiring is installed exposed, wiring is to be routed parallel or perpendicular (right-angles) with building and/or mechanical lines and neatly tied at 2 m (6’) intervals.

G. Exposed cabling shall be mechanically supported to structural members with D-rings or an equivalent device specifically designed for this purpose.. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping or ceiling suspension systems.

H. Exposed cabling shall be installed in sleeves where the route passes through walls, floors and other partitions. Maintain fire, smoke, envelope and pressure ratings of each space.

I. All wiring in mechanical, electrical or service rooms, or where subject to mechanical damage shall be installed in UL-Listed raceway or conduit.

J. Class 2 wiring shall not be installed in in raceways or conduit containing Class 1 wiring. Junction boxes, enclosures and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays, transformers, CTs, etc.). Refer to the requirements of the applicable code enforcing authorities and AHJ.

K. NEC Chapter 7 Article 725 – Class 1, Class 2 and Class 3 Remote-Control, Signaling and Power-Limited Circuits.

L. CSA C22.1-12 Rule 16-212 Separation of Class 2 circuit conductors from other circuits

M. Sizing and selection of raceways, enclosures and conduit shall be the responsibility of the BAS Contractor in keeping with the manufacturer's recommendations and the requirements of NEC, CSA C22.1-12, the Electrical System Specifications and any/all applicable local codes and/or AHJ.

N. Conceal all raceways and conduit, except within mechanical, electrical or service spaces.

O. Install raceways and conduit to maintain a minimum clearance of 15 cm (6") from high-temperature equipment (e.g., steam lines, flues, etc.).

P. Secure and support raceways and conduit to the structure per the manufacturer's recommendations. Raceways and conduit may not be hung on flexible straps or tie rods, nor may they be attached to ductwork.

Q. Comply with the requirements of the Electrical System Specifications when raceways or conduit crosses building expansion joints.

R. Include a minimum of one (1) pull string in each raceway or conduit extended a minimum of 15.2 cm (6").

S. Flexible metal raceways, liquid-tight and other non-rigid conduit shall not exceed 1 m, (3') in length and shall be mechanically supported at each end.

T. Flexible metal raceways, liquid-tight and other non-rigid conduit smaller than 12 mm (0.5") shall not be used.

U. Wire-to-device connections shall be made in enclosures or approved junction boxes with a maximum fill of 50%.

V. Devices with terminals shall be terminated at the device terminals. Splices will not be permitted.

W. Wherever possible device terminations shall be made in the enclosure provided with the device.

X. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

Y. Use color-coded conductors consistently throughout the entire BAS installation.

Z. Maximum allowable voltage for control wiring shall be 120 volts.

AA. The BAS Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

BB. Maximum pulling, tension, and bend radius for cable installation as specified by the manufacturer shall not be exceeded during installation.

CC. The BAS Contractor shall verify integrity of all wiring to ensure continuity and freedom from shorts and grounds after the installation is complete.

DD. When any cable enters or exits the building a lightning arrestor must be installed between the conductors and ground. The lightning arrestor shall be installed according to the manufacturer's recommendations.

3.06 COMMUNICATION WIRING

A. Communication and network wiring shall adhere to the Wiring article in Part 3 of this specification and the manufacturer's recommendations.

B. Communication wiring shall not be installed in any raceway or conduit with Class 1 wiring.

C. All communication wiring shall be installed as continuous lengths, with no splices permitted between termination points.

D. All communications wiring shall be a consistent color designated for the particular network. MS/TP networks shall be of one color end to end. Color changes shall not be permitted. All CAT6/CAT5E cabling shall be the same color.

E. All communication cabling shall be labelled to indicate origination and destination devices.

F. All communications shielding shall be grounded as per manufacturer's recommendations and in accordance with the NEC/CSA (as applicable).

3.07 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels shall be labelled at each end within 5 cm (2") of the termination with the BACnet® object instance or termination number.

B. Manufacturer's name plates and UL or CSA labels are to be visible and legible after equipment is installed.

C. All labels and identifiers shall match record documents.

D. All wiring labels are to be created with a label maker. Hand-written labels shall not be acceptable.

3.08 PROGRAMMING

A. Provide sufficient internal memory for the specified sequences of operation and data logging with a minimum of 25% of available memory remaining free for future use.

B. Utilize a device addressing scheme that is appropriate for the requirements of the physical media as well as being such that it can be consistently expanded over the entire campus. Simply relying on factory default addressing will not be acceptable. This scheme shall be subject to owner approval.

C. At time of acceptance, all operating systems, BAS software and hardware shall be the latest official release version available.

D. Unless otherwise specified, BAS shall be programmed using a standard naming convention. Objects names shall be modular in design, allowing easy operator interface without the use of a written object index. Use the following naming convention: AA-BBBBCCC-DDDDEE where:

E. AA is used to designate the service location (e.g., room, floor, building, etc.).

F. BBBB is used to designate the mechanical system with which the object is associated (e.g., AH, CHWS, HTG, CLG, LTG, etc.).

G. CCC represents specific mechanical systems or pieces of equipment (e.g., 01, etc.).

H. DDDD represents the equipment, device or material referenced (e.g., SF (supply fan), RF (return fan), DA (discharge air), etc.).

I. EE represents the action or state of the equipment or measured medium (e.g., T (temperature), RH (relative humidity), P (pressure), etc.).

J. Program the BAS to adhere to this specification and to fully incorporate the features described. Optimize the program to provide the Sequences of Operation, minimize energy consumption and prolong equipment life.

K. All BAS programming necessary for the operation of the system to satisfy the design intention and performance requirements, but not specified in this document, shall be provided by the BAS Contractor at the direction of the Engineer.

L. Imbed in the programming sufficient comment statements and descriptions to clearly describe each section of the program. Comments shall reflect the language of the specified sequences of operation.

M. Provide graphical user interface (GUI) consistent with the requirements of this specification and the Sequences of Operation. At a minimum:

N. Provide dynamic graphics for all mechanical systems and/or each individual piece of mechanical equipment.

O. All physical hardware, sensors, control devices and set-points shall be visible in graphical format.

P. All hardware inputs shall be programmed with appropriate alarms, configured to indicate genuine alarm conditions and/or failure to control while preventing nuisance alarm notification.

Q. Unless otherwise specified, all set-points shall be adjustable.

R. At a minimum, every analog hardware point shall be trended and every binary hardware point shall have active and cycle times logged consistent with the specification requirements for trend logs and runtime logs. At a minimum, all software (virtual) set-points, control loops and operational modes shall be likewise trended and/or logged.

S. Interrelated objects shall be logically grouped into Trend Log Multiple objects for individual mechanical and building systems. Unless otherwise scheduled, initial set-up shall be to log values once every 15 minutes.

T. The system shall observe the following standard BACnet® command priorities (from highest to lowest):

U. Smoke Control and Life Safety (Priority Level 1 & 2).

V. Manual Operator Command (Priority Level 8).

W. Energy Management (Priority Level 9).

X. Normal Automatic Control (Priority Level 10).

3.09 TEST & BALANCE

A. The BAS Contractor shall provide a single set of all tools required to interface with the System for the purposes of Test & Balance.

B. The BAS Contractor shall provide instruction in the use of all tools required to interface with the System for the purposes of Test & Balance.

C. The BAS Contractor shall provide a qualified technician to assist in the test & balance for a period of sixteen (16) hours minimum.

3.10 BAS CHECK-OUT AND TESTING

A. All testing listed in this article shall be performed by the BAS Contractor. This testing shall be completed before system demonstration is initiated.

B. The BAS Contractor shall furnish all of the necessary labor and test and calibration apparatus required to calibrate and prepare for service all instruments, controls, and accessory equipment provided under this specification.

C. Verify that all control terminations are tight and all control wiring is proper and free from shorts and faults.

D. Enable normal operational control and verify calibration of all input devices individually according to manufacturer's recommendations.

E. Verify the operation of all output devices including action, normal positions, fail-safe positions, start and span, and travel.

F. Set all set-points to their initial and/or startup values prior to testing against specified sequences.

G. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation.

1. Tune all control loops and optimum start/stop routines.

2. Check each alarm separately by providing an appropriate signal to trip the alarm.

3. Trip all safeties and interlocks to verify proper operation and fail-safe response.

H. As each device is tested a log shall be completed showing the date, technician's initials and any corrective action taken as a result of operational failures. This log shall be submitted prior to scheduling acceptance demonstration and for inclusion in the final O&M manuals.

3.11 CONTROL ACCEPTANCE AND DEMONSTRATION

A. Prior to acceptance, the BAS shall undergo a series of performance tests to verify proper operation and compliance with this specification.

B. The tests described in this section are in addition and subsequent to the tests necessary for start-up, tuning, debugging and compliance with the requirements of the Check-out and Testing section of this specification. The Engineer or an appointed representative shall be present at the tests specified in this section and shall be notified ten (10) working days prior to the testing procedures.

C. The BAS Contractor shall provide at least two (2) qualified technical personnel equipped with means for two-way communication to demonstrate the actual operation of all control operations and modes including occupied, unoccupied, seasonal changeover and emergency/fail-safe operation.

D. Compliance with this specification shall be demonstrated including all specification sections, schedules, drawings and Sequences of Operation.

E. Demonstrate operator interface compliance with the requirements of the specification.

F. Additionally, the following shall be demonstrated:

G. Control loop response shall be proven in the form of trend data in a graphical format displaying the actual response to process variables of each control loop.

1. Trends shall include the process variable, set-point, loop output and physical output position.

2. Trends shall show the loop's response to a change in set-point.

3. The sampling rate shall be between 10 seconds and 3 minutes.

4. Leading or following loops shall be required to be tuned by the BAS Contractor.

H. Operational logs for each system that demonstrate normal operation.

1. Trends shall include the process variable, set-point, loop output and physical output position, operational mode and equipment status.

2. Trends shall cover three (3) 48-hour periods with a sampling interval of not more than 10 minutes.

I. At the discretion of the Owner/Engineer trends from a random sampling of 25% of unitary controllers/applications may be submitted.

J. Database backup of the entire network and database restoration for selected controllers.

K. As each device is tested a log shall be completed showing the date, technician's initials and any corrective action taken as a result of operational failures.

L. The BAS Contractor shall display using a third-party data packet analytical tool that all BAS data including operator interface requests are being performed using BACnet®.

M. Any tests that fail to demonstrate the operational compliance of the BAS shall be repeated at a later date when the issues have been resolved. The BAS Contractor shall be responsible for any necessary repairs or revisions to successfully complete all tests.

N. When all of the tests and documentation described herein have been successfully completed to the satisfaction of the specification, the Owner and the Engineer the BAS shall be accepted as complete within fourteen (14) calendar days.

O. Any tests that cannot be performed due to circumstances beyond the control of the BAS Contractor may be performed at the discretion of the Owner after acceptance and as a part of the warranty period.

3.12 CLEANING

A. The BAS Contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his/her control as soon as their contents have been removed.

B. At the completion of work in any area the BAS Contractor shall clean all work, equipment, etc. keeping it free from dust, dirt, debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any other factory finish damage shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed or damaged shall be replaced with new material and painted to match the adjacent areas.

3.13 TRAINING

A. The BAS Contractor shall provide instruction on the adjustment, operation and maintenance of the BAS including all hardware and software provided and installed in compliance with the requirements of this specification.

B. Training shall be performed by a manufacturer’s representative and/or instructor or a manufacturer-trained application engineer and/or technician with sufficient experience in the installation, programming and operation of the BAS.

C. All training equipment and material shall be provided by this Contractor.

D. Training in the operation of the BAS shall be performed utilizing a BACnet® network of working controllers representative of the installed network and/or the Owner’s facility and shall include:

E. Overview of the installed system and network architecture.

F. BAS components.

G. Graphical User Interface (GUI) operation.

H. Day-to-day operations including modification of system set-points, schedules, calendars, manual overrides, trending, log retrieval, alarm handling, etc.

I. Software operation, including navigating the workstation displays, database management, troubleshooting, diagnostics, report generation, etc.

J. Database design and modification including adding objects, modifying routines, optimizing operation, etc.

K. General operation of the workstation hardware and peripherals.

L. On-site walk-through shall cover the deployment and execution of the complete BAS and components including:

M. Sequences of Operation.

N. Location of all panels, enclosures, controllers, devices, sensors, etc. and equipment and panel lay-out.

O. Hardware preventive maintenance, calibration, troubleshooting, maintenance and repair.

P. Proper use of service tools and materials.

3.14 INSTRUCTIONS TO OTHER CONTRACTORS

A. Control Valve Installation. Control valves shall be installed in accordance with the manufacturer's recommendations and in compliance with this specification.

B. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal positions.

C. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.

D. Isolation valves shall be installed so that the control valve body may be serviced without draining the piping system. Unions or flanges shall be provided at all connections to control valves.

E. Provide tags for all controls valves indicating service and identifier. Secure tags with chain and hook. Identifiers shall match approved control shop drawings.

F. Control Damper Installation. Control dampers shall be installed in accordance with the manufacturer's recommendations and in compliance with this specification.

G. Damper submittals shall be coordinated for type, quantity and size to ensure compatibility with sheet metal design.

H. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Inside clear duct openings shall measure 6 mm (1/4") larger than damper actual outside clear dimensions and shall be square, straight and level.

I. Individual damper sections as well as entire multiple section assemblies must be completely square and free from racking, twisting or binding. Diagonal measurements from upper corners to opposite lower corners must be within 3 mm (1/8") of one another.

J. Unless specifically designed for vertical blade orientation, dampers must be installed with blade axis horizontal.

K. Damper blades, shafts, and linkages must operate without binding. On multiple section assemblies, blades must open and close simultaneously.

L. Provide a visible and accessible indication of damper position on the drive shaft end.

M. Support ductwork in area of damper when required to prevent sagging due to damper weight.

N. After installation caulk between frame and duct and/or opening to prevent leakage around perimeter of damper.

O. Original Equipment Manufacturer Provided Controls. All OEM package DDC devices provided for this project shall completely comply with all of the requirements of this specification section.

P. Provider of the OEM equipment/controls shall bear exactly the same burden of responsibility for products provided in other sections of this specification as the BAS Contractor.

Q. A Protocol Implementation Conformance Statement (PICS) including a BACnet® Interoperability Building Block (BIBB) table shall be provided for any DDC device (hardware and software) provided to be integrated to the BAS.

END OF PART 3

SECTION 260500 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. Section includes general electrical requirements related to all Division 26 Sections.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Other standards, organizations, and agencies are listed in individual Specification Sections.

1.4 COORDINATION

A. Coordinate sequencing, arrangement, required clearances, mounting, and support of electrical equipment with other Divisions of work.

B. Coordinate all power requirements for all specified equipment provided by others (including, but not limited to plumbing, mechanical, kitchen and owner supplied equipment) during the coordination drawing process and before ordering equipment. Notify the Construction Manager immediately if any conflicts arise. No cost for electrical conflicts will be approved once coordination drawings are complete and equipment is ordered.

1.5 RATED CONSTRUCTION

A. Maintain integrity of fire-rated construction where penetrated by electrical work.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Construction Manager's written permission.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Coordinate connection of electrical service with utility provider. Comply with utility provider requirements and local codes and regulations.

C. Coordinate connection of branch circuits and feeders to equipment furnished under other Divisions.

D. Measure indicated mounting heights to bottom of unit for suspended items and wall-mounted items, unless noted otherwise.

E. 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.

F. Sequence for efficient flow of installation and positioning prior to closing in of building. Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Provide for ease of disconnecting of equipment with minimum interference to other installations.

G. Arrange raceways, cables, wireways, cable trays, and busways to be clear of obstructions and of the working and access space of other equipment.

H. Give right of way to piping systems installed at a required slope.

I. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

J. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Refer to Division 08 Section "Access Doors and Frames."

K. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Comply with Division 07 Section "Penetration Firestopping."

L. Comply with Division 01 Section "Cutting and Patching" restoration of surfaces disturbed by electrical installation.

M. Paint finished surfaces damaged during electrical installation, matching color and type of paint. Follow manufacturer's written instructions for surface preparation and application. Apply successive coats required to restore finish equal to the unblemished areas.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE 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.

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. This Section includes building wires and cables, and associated connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

A. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Comply with NFPA 70.

C. Comply with NEMA WC 3, NEMA WC 5, NEMA WC 7, NEMA WC 8.

D. Comply with NEMA WC 70.

E. Comply with NECA, Standards for Installation.

F. Conductor Connection Torque Value UL 486A

G. Conductor Connectors UL 486B

H. UL Standard 44 for Aluminum Conductors

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified.

B. Branch Circuit Conductors: Copper, solid conductor for No. 14 AWG or smaller, stranded conductor for larger than No. 14 AWG. Minimum size, No. 12 AWG for branch circuits, No. 14 AWG for control wiring.

C. Feeder Conductors: Copper **.** Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Selection of Insulation and Cable Types:

1. Insulation: THHN-THWN for indoor copper wiring, XHHW for outdoor and underground copper wiring, and XHHW-2 for all aluminum wiring.
2. Multiconductor Cable: Copper Conductor metal-clad cable, Type MC for use above ceilings and in gypsum board walls. Coordinate with Wiring Method Tables on Drawings.
3. Manufactured Cable Systems: Manufactured cabling, connectors, tees, splices, and components for a complete branch circuit system for lighting. System is limited to wiring between light fixtures located in accessible acoustical tile ceilings and from junction box located above ceiling to fixtures. Conduit shall be provided from light fixture switch location to junction box located above ceiling.

2.2 CONNECTORS AND SPLICES

A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 MATERIAL SELECTION

A. Refer to wiring method schedule on drawings.

3.2 CONDUCTOR SIZING

A. Feeders – refer to single line diagram.

B. Branch Circuits – Unless otherwise noted on the plans, providing the following minimum conductor sizes. Contractor shall increase size as required to accommodate voltage drop and special conditions. Neutral conductors shall be full size.

Breaker/Fuse Size	Wire Size	Equipment Grounding Wire Size
15A	#12	#12

20A	#12	#12
25A	#10	#10
30A	#10	#10
35A	#8	#10
40A	#8	#10
45A	#8	#10
50A	#8	#10
60A	#6	#10
70A	#4	#8
80A	#4	#8
90A	#2	#8
100A	#2	#8

3.3 EXAMINATION

A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.4 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA "Standard of Installation."

B. 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.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Electrical Supports."

F. Identify and color-code conductors and cables according to Division 26 Section "Electrical Identification."

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors. Minimize number of splices.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections: For feeders and service entrance conductors, upon completion of the installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification.
2. Certify compliance with test parameters.
3. Remove and replace malfunctioning conductors and cables, and retest to demonstrate compliance.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. Section includes grounding systems and equipment for safe and protective operation of electrical components.

B. Related Sections include the following:

1. Division 26 Section "Low-Voltage Conductors and Cables".

1.3 SUBMITTALS

A. Product Data: For ground bus bars.

B. Informational Submittals: Field quality-control reports and plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

C. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Instructions for periodic inspection, including recommended intervals, of grounding features based on NFPA 70B.

1.4 QUALITY ASSURANCE

A. Comply with NPFA 70.

B. Comply with UL 467.

C. Comply with IEEE C2 (underground distribution components).

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. General:

1. Material: Copper.
2. Solid Conductors: ASTM B3.
3. Stranded Conductors: ASTM B8.

B. Grounding Electrode Conductors: Bare, stranded cable, unless indicated otherwise.

C. Equipment Grounding Conductors: Insulated.

D. Bonding Conductors: Bare, stranded cable, unless indicated otherwise.

2.2 CONNECTORS

A. Bolted Clamps: Heavy-duty type.

B. Compression and Pressure Connectors: High-conductivity plated type.

C. Exothermic-Welded Connectors: Kits of types recommended by manufacturer for materials being joined and installation conditions.

D. Grounding Busbar Connectors: Mechanical type, cast silicon bronze, compression-type wire terminals, and long-barrel, two-bolt connection.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 by 96 inches.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. General: Where sizes, types, and ratings indicated exceed the requirements of NFPA 70, the more stringent requirements and larger sizes, types, and ratings are to be used.

B. Separately Derived Systems: Refer to Drawings.

C. Equipment Grounding Conductors:

1. Install insulated equipment grounding conductors with all feeders and branch circuits.

2. Busway Supply Circuits: Install separate conductor from ground bus in the switchgear, switchboard, or distribution panel to busway ground bar.

3. Computer and Rack-Mounted Electronic Equipment Circuits: Install dedicated conductor for each branch circuit run.

4. Isolated Grounding Receptacle Circuits: Install conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

D. Metal 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.

E. Grounding Manholes:

1. Ground Rode: Install a driven ground rod through floor, close to wall, and set rod depth so 4 inches will extend above finished floor. Provide double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
2. Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields to ground rod. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.2 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. Grounding:

1. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

2. Metal Water Service Pipe: Install grounding electrode conductor, from building's main service equipment, or grounding bus, to main metal water service entrances to building.

a. Water Meter Piping: Provide bonding jumpers to electrically bypass water meters.

3. Ufer Ground: Fabricate as indicated on Drawings.

4. Steel Structure: Connect to grounding electrode system as indicated on Drawings.

C. Bonding:

1. Gas Piping: Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
2. Metal Air Ducts: Bond to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install jumpers across flexible duct connections to maintain continuity.
3. Metal Piping: Bond each aboveground portion of metal piping systems.

3.3 CONNECTIONS

A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be compatible, and free of galvanic action.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Compression Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use compression type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

E. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing.

1. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing.
2. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

F. Piping: Use a bolted clamp connector.

G. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.4 FIELD QUALITY CONTROL

A. Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, inspect 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. Prepare dimensioned Drawings locating each ground rod, other grounding electrodes, and grounding arrangements and connections for separately derived systems.

B. Grounding system will be considered defective if it does not pass inspections.

C. Prepare inspection reports.

END OF SECTION 260526

SECTION 260529 - ELECTRICAL SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. This Section includes supports for electrical equipment and systems.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for concrete materials, reinforcement, and placement requirements.
2. Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with UL5B.

C. Comply with MFMA-4.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

A. Finishes: Hot-dipped galvanized carbon steel, zinc-plated carbon steel, or stainless steel as indicated on Wiring Methods Schedule on Drawings.

B. Strut Support Systems: Slotted steel channel, galvanized according to ASTM A123 or ASTM A653. Select channel size appropriate for applicable load criteria. Provide fittings, channel hardware, brackets, angles, inserts, hangers and accessories required for a complete support system. Obtain components from single manufacturer.

C. Rooftop Support Systems: Rubberized or polypropylene base, UV resistant, with galvanized stand-off rods and channel supports. Select size appropriate for applicable load criteria.

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

a. Cooper B-Line.
b. ERICO International.
c. Miro Industries.
d. PHP Systems/Design.

D. Raceway and Cable Support Devices: As described in NECA 1 and NECA 101, steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Hanger Rods: Threaded steel, zinc plated, minimum 1/4" diameter.

F. Support for Conductors in Vertical Conduit Required if length exceeds NEC Table 300.19: Factory-fabricated assembly consisting of threaded, malleable-iron body and insulating wedging plug with number, size, and shape of gripping pieces as required for type of conductor.

G. Fabricated Metal Supports: Welded or bolted, structural-steel shapes meeting ASTM A36, shop or field fabricated to fit dimensions of supported equipment.

2.2 ANCHORAGE AND FASTENERS

A. Finishes: Hot-dipped galvanized carbon steel, zinc-plated carbon steel, or stainless steel as indicated on Wiring Methods Schedule on Drawings.

B. Bolts: Hexagon head.

1. General: ASTM A307, Grade A.
2. Stainless: ASTEM F593, Group 1.
3. Anchor: ASTM F1554, Grade 36.
4. Structural: ASTM A325.

C. Nuts: Hexagon.

1. General: ASTM A563, Grade A.
2. Stainless: ASTM F594, Group 1.
3. Anchor: Selected for load per ASTM A563.
4. Structural: Selected for load per ASTM A563.

D. Screws:

1. Machine Screws: Pan head or hexagon head, ASME B18.6.3.
2. Sheet Metal Screws: Self-tapping type, pan head or hexagon head, ASME B18.6.4.
3. Lag Screws: Hexagon head, ASME B18.2.1.
4. Wood Screws: Flat head, ASME B18.6.1.

E. Flat Washers: Plain, round.

1. For General Bolts and Nuts: ASTM F844.
2. For Stainless Bolts and Nuts: Material selected to match nuts.
3. For Anchor Bolts or Structural Bolts: ASTM F436.
4. Washers For Screws: ASME B18.22.1

F. Lock Washers: Helical, spring-type, round.

1. General: ASME B18.21.1.
2. Stainless: Material selected to match fastener.

G. Toggle Bolts: Spring-wing type, mounted on trunnion nut, with machine screw.

H. Eyebolts: ASTM A489.

I. Anchors for Cast-in-Place Concrete: Threaded type or wedge type, galvanized. ASTM A47 malleable iron or ASTM A27 cast steel.

J. Expansion Anchors: Threaded-stud wedge-type or sleeve-type

2.3 CONCRETE BASES

A. Use 3000-psi28-day compressive-strength concrete.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Select materials and finishes for hangers, supports, anchors, and fasteners as indicated on Wiring Methods Schedule on Drawings.

C. Comply with manufacturer's recommendations for selecting and installing supports.

D. Design supports for multiple raceways for combined weight of supported systems, plus a 10 percent minimum future load.

E. Design equipment supports capable of supporting combined weight of supported equipment and connected systems.

F. Rated Strength of Supports: Adequate to carry present and future static loads within specified loading limits, times a minimum safety factor of three.

G. Select and anchorage and fasteners as follows:

1. Wood: Lag screws, wood screws, or bolts.
2. New Concrete: Bolt with cast-in-place concrete anchors.
3. Hollow Masonry Units: Toggle bolts.
4. Solid Masonry Units: Expansion anchor fasteners.
5. Existing Concrete: Expansion anchor fasteners.
6. Light Steel: Sheet metal screws.

3.2 HANGER AND SUPPORT INSTALLATION

A. Strut Support Systems: Install as a complete system, including fittings, channel hardware, brackets, angles, inserts, hangers and accessories required.

B. Install U-bolts, clamps, attachments, hanger rod, and other accessories required to secure supports.

C. Multiple Raceways: Install trapeze-type supports fabricated with strut support system. Secure raceways to supports with clamps appropriate for raceway.

D. Individual Raceways: Support with separate pipe hangers or clamps. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-inch and smaller raceways above suspended ceilings.

E. Equipment: Support with strut system where substrate or structural elements do not provide adequate strength of support.

F. Support for Conductors in Vertical Conduit Required if length exceeds NEC Table 300.19: Install at top of raceway and at intervals required by NFPA 70 to support cables without load on conduit ends or terminations.

G. Fabricated Metal Supports: Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Comply with Division 05 Section "Metal Fabrications".

3.3 ANCHORAGE AND FASTENER INSTALLATION

A. Securely fasten electrical items and supports to building structural elements according to application.

1. Install beam clamps for attaching to structural steel. Do not weld to structural steel.
2. Do not fasten or anchor to steel roof deck.
3. Drill holes for expansion anchors in concrete and solid masonry at locations and depths that avoid reinforcing bars.

3.4 CONCRETE BASES

A. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate size and location of concrete bases.

1. Construct for 4-inch nominal thickness, and to be not less than 4 inches larger in both directions than supported equipment, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

C. Cast anchor-bolt inserts into bases and fasten equipment to concrete base. Install according to manufacturer's written instructions.

1. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
3. Install anchor bolts to elevations required for proper attachment to equipment.

END OF SECTION 260529

SECTION 260533 - RACEWAYS, CABLE TRAYS, AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, cable tray, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for floor service boxes and fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

F. RTRC: Reinforced thermosetting resin conduit.

1.4 SUBMITTALS

A. Product Data: Include data indicating dimensions, finishes, and accessories for surface raceways, cable trays, handholes, manholes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Include plans, elevations, sections, and details for the following:

1. Custom enclosures and cabinets.
2. For handholes and manholes, including the following:

a. Duct entry provisions, including locations and duct sizes.
b. Frame and cover design.
c. Grounding details.

d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
e. Joint details.
f. Ladder details for manholes.

C. Samples for Initial Selection: For surface raceways with factory-applied texture and color finishes.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Comply with NFPA 70.

C. Comply with NECA 1.

1.6 COORDINATION

A. Coordinate layout and installation of conduit, manholes, handholes, and pull boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. Aluminum Rigid Conduit: ANSI C80.5.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket. UL 360.

G. Fittings: NEMA FB 1, compatible with conduit/tubing used.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Set-screw or compression type.

2.2 NONMETALLIC CONDUIT AND TUBING

A. RNC: NEMA TC 2, Schedule 40 or Schedule 80.

B. RTRC: NEMA TC 14.

C. Fittings: Compatible with conduit/tubing used.

1. RNC: NEMA TC 3.
2. RTRC: NEMA TC 14.

2.3 RACEWAY SLEEVES

A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: 24-gage galvanized sheet steel of length to suit application.

2.4 SURFACE RACEWAYS

A. Surface Raceways – Single Channel: One-piece construction, galvanized steel, white or ivory finish (color to be selected by Architect). Provide fittings and accessories including, but not limited to, elbows, couplings, wire clips, end fittings, device mounting brackets, and plates as required for a complete system. Provide accessories suitable for devices, outlets, and wiring and cable as indicated on Drawings.

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

a. Wiremold 700 Series (Basis of Design)
b. Hubbell Wiring Device-Kellems.
c. Mono-Systems.
d. Thomas & Betts Corporation.

2.5 METAL WIREWAYS

A. Description: Sheet metal sized and shaped as required, hinged or screw cover type, NEMA rating as indicated on Drawings, manufacturer's standard finish. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings as required for complete system.

2.6 DEVICE AND OUTLET BOXES

A. Sheet Metal Boxes: NEMA OS 1.

B. Cast-Metal Boxes: NEMA FB 1, Type FS or FD, with threaded hubs and gasketed cover.

C. Nonmetallic Boxes: NEMA OS 2.

2.7 JUNCTION AND PULL BOXES

A. Sheet Boxes: NEMA OS 1.

B. Cast-Metal Boxes: NEMA FB 1, Type FS with threaded hubs and gasketed cover.

2.8 CONDUIT BODIES

A. Conduit Bodies: UL 514B, with threaded hubs and gasketed cover.

2.9 ENCLOSURES AND CABINETS

A. Hinged-Cover Enclosures: Continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, manufacturer's standard finish.
2. Nonmetallic Enclosures: Plastic.

B. Cabinets: Galvanized-steel box with removable interior panel and removable front, with manufacturer's standard finish.

1. Hinged door in front cover with flush latch and concealed hinge.
2. Key latch to match panelboards.
3. Metal barriers to separate wiring of different systems and voltage.
4. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation.

1. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 MATERIAL SELECTION

A. Raceways and Boxes: Refer to Wiring Methods Schedule on Drawings.

3.3 GENERAL INSTALLATION

A. Install raceways, boxes, enclosures, and cabinets according to manufacturer's written instructions.

B. Install raceways, boxes, enclosures, and cabinets to form a continuous electrical conductor.

C. Do not install raceways under slab, unless otherwise indicated on Drawings.

3.4 RACEWAY INSTALLATION

A. 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.

B. Complete raceway installation before starting conductor installation. Use temporary closures to prevent foreign matter from entering raceways.

C. Separate Raceway Systems: Provide separate raceways for the following:

1. Emergency circuits.
2. Conductors operating at different voltages
3. AC and DC/analog control wiring

D. Support raceways as specified in Division 26 Section "Electrical Supports."

E. Routing: Install raceways level and square and at proper elevations. Provide adequate headroom.

1. Install exposed and concealed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical. Run parallel or banked raceways together, on common supports where practical.
2. Conceal conduit and tubing within finished walls and ceilings, unless otherwise indicated.
3. Do not embed raceways in slabs.
4. Route underground raceways with a minimum of bends, in the shortest practical distance considering other underground utilities and obstructions, unless otherwise indicated.

F. Bends: Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

1. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
3. Arrange stub-ups so curved portions of bends are not visible above the finished floor.

G. Fittings, Joints and Terminations: Join raceways with fittings designed and approved for the purpose and make joints and terminations tight.

1. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
2. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
3. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
4. Use insulating bushings to protect conductors.
5. Tighten set screws of threadless fittings with suitable tools.
6. Protect stub-ups from finished floors from damage.
7. 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.
8. RNC Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to ASTM F 402, ASTM D 2564, and ASTM F 656.

H. Pull Wires: Install pull wires in empty raceways.

1. Raceways For Electric Telephone, Communications, or Data Utility Service Cables: Comply with Utility company requirements.
2. Raceways for Electric Branch Circuits: Use monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

I. Direct-Buried Conduit:

1. Excavate trench and backfill as specified in Division 31 Section "Earth Moving."
2. Slope: Pitch conduit a minimum slope of 1:300 down away from buildings and equipment.
3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor. Provide adapters for change in raceway material as required.
4. For stub-ups at equipment, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation.

J. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound, according to manufacturer's written instructions. Locate fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where conduits pass from interior to exterior locations.
3. Where otherwise required by NFPA 70.

3.5 RACEWAY PENETRATIONS

A. Concrete Slabs and Walls: Install sleeves during erection of slabs and walls, unless core-drilled holes or formed openings are used.

B. Fire-Rated Assemblies: Install sleeves and seal with firestop for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall. Cut sleeves to length for mounting flush with both surfaces of walls or extend sleeves installed in floors 2-inches above finished floor level.

C. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

D. Roof Penetrations: Utilize roof curbs and internal wireways for equipment where available. Provide flexible, boot-type flashing units applied in coordination with roofing work where individual raceways penetrate the roof.

E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

3.6 BOX INSTALLATION

A. 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. 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.

B. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

C. 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.

3.7 ENCLOSURE AND CABINET INSTALLATION

A. Install hinged-cover enclosures and cabinets and rigid without distortion of box. Support at each corner.

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

3.9 CLEANING

A. Surface Raceways: Clean exposed surfaces as recommended by manufacturer.

Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts. END OF SECTION 260533

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. Section includes identification for electrical equipment, materials, and installations.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with ANSI A13.1.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with UL 969.

1.4 COORDINATION

A. Coordinate installation of identification after completion of field-finished surfaces where identification is applied to such surfaces.

B. Coordinate installation of identification prior to installation of acoustic ceilings, access panels, and similar concealments.

PART 2 - PRODUCTS

2.1 RACEWAYSAND METAL-CLAD CABLES

A. Raceways Carrying Circuits at More Than 600V: Preprinted, flexible self-adhesive vinyl labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

1. "DANGER--HIGH VOLTAGE" inscription with 2-inch high black letters on an orange field.

B. Raceways Carrying Circuits at 600 V or Less:

1. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, colored acrylic sleeve, 2-inches wide, with diameter sized to suit raceway being identified.
2. Self-Adhesive Colored Vinyl Tape: Heavy-duty, fade resistant, 2-inch wide. Waterproof and compounded when used in exterior applications.
3. Paint: Comply with Division 09 for paint materials and application requirements.
4. Factory-Applied Color Coating.

2.2 CABLES AND CONDUCTORS

A. Factory-Applied Conductor Color: Color the entire length of the conductors for sizes No. 10 AWG or smaller for phase conductors, and No. 6 AWG or smaller for grounded conductors.

B. Field-Applied Conductor Color: Self-adhesive colored vinyl tape, 3-mils thick, 1-inches wide for sizes larger than No. 10 AWG for phase conductors, and No. 6 AWG for grounded conductors.

C. Heat-Shrink Markers: White polyolefin sleeves, text applied with compatible printer.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with preprinted letters and numbers.

2.3 ELECTRICAL EQUIPMENT

A. Nameplates: Engraved, melamine plastic laminate stock, punched for fasteners, white letters on a black field. Provide a single line of text with 1/2-inch-high lettering on 1-1/2-inch-high stock; where two lines of text are required, use 2-inch-high stock.

B. Labels: Self-adhesive polyester label, machine printed.

C. Warning Labels: Self-adhesive polyester label with clear protective overlay, machine printed. Labels shall include, but are not limited to, the following legends:

1. Arc Flash and Shock Hazard Warning: "DANGER--ARC FLASH AND SHOCK HAZARD. APPROPRIATE PERSONAL PROTECTION EQUIPMENT REQUIRED."
2. Multiple Power Source Warning: "DANGER--ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
3. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

D. Fasteners for Nameplates: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.4 SIGNAGE

A. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with 1/4-inch grommets in corners for mounting. Colors, legend, and size as required for application.

B. Metal-Backed, Butyrate Signs for Exterior Use: Cellulose-acetate butyrate signs, weather-resistant, fade-resistant, preprinted, with 1/4-inch grommets in corners for mounting. Colors, legend, and size as required for application.

C. Emergency Operating Instruction Signs: White lettering on a red background with minimum 3/8-inch-high letters for emergency instructions.

D. Fasteners for Signage: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.5 FLOOR MARKING TAPE

A. 5-mils thick, 2-inch wide, pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 MOTORS

A. Tags: Stainless steel disc, approximately 1- inch diameter, complete with hole for seven strand stainless steel wire. Stamp tag with equipment designation and circuit, in 1/4-inch high letters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install identification according to manufacturer's written instructions in a secure manner, located for most convenient viewing without interference with operation and maintenance of equipment.

B. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

C. Accessible Raceways and Exposed Cables: Locate 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.

1. Color-Coding: Refer to Conductor and Conduit Color Coding Schedule on Drawings. Each color-coding band or tape shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side.
2. Paint: Coordinate with Division 09.
3. Raceways Carrying Circuits More Than 600V: Identify at 10-foot intervals.

D. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

E. Conductors: Identify conductors and cables in enclosures and at junction boxes, terminals, and pull points.

1. Color-Coding: Refer to Conductor and Conduit Color Coding Schedule on Drawings. For field-applied tape, apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape without tension to prevent possible unwinding. Locate tape to avoid obscuring factory conductor markings.

2. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
3. Multiple Power Conductors in Same Enclosure: Identify each conductor with source and circuit number. Use color coding for voltage and phase indication.
4. Multiple Control and Communications Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color coding, or cable marking tape.
5. Control Wiring: Label both ends of conductor with control wire number as indicated on schematic and wiring diagrams, and manufacturer's shop drawings and Operation and Maintenance Manual.

F. Pull Boxes and Junction Boxes: Identify source and circuit number.

1. Exposed Boxes: Identify on inside of cover with label or written in permanent marker.
2. Boxes Above Finished Ceilings: Identify on outside of cover with label or written in permanent marker.

G. Wiring Device Boxes: Identify source and circuit number with label on inside of wallplate.

H. Electrical Equipment: Identify each unit of equipment, consistent with wiring diagrams and schedules.

1. Nameplates: Apply identification to systems including power, lighting, control, communication, signal, monitoring, and alarm systems, unless equipment is provided with its own self-explanatory identification. Identify the following equipment:

    a. Panelboards, enclosures, and electrical cabinets.
    b. Access doors and panels for concealed electrical items.
    c. Substations.
    d. Switchgear.
    e. Switchboards.
    f. Transformers.
    g. Motor-control centers.
    h. Enclosed switches.
    i. Enclosed controllers.
    j. Variable-speed controllers.
    k. Push-button stations.
    l. Power transfer equipment.
    m. Contactors.
    n. Remote-controlled switches, dimmer modules, and control devices.
    o. Battery-inverter units.
    p. Battery racks.
    q. Power-generating units.
    r. UPS equipment.
    s. Telephone switching equipment.
    t. Clock/program master equipment.
    u. Call system master station.
    v. TV/audio monitoring master station.
    w. Fire alarm master station or control panel.
    x. Security-monitoring master station or control panel.
2. Warning Labels for Electrical Equipment: Install where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect.

    a. Install Arc Flash and Shock Hazard labels at the following equipment:

1) Panelboards.
2) Substations.
3) Switchgear.
4) Switchboards.
5) Transformers.
6) Motor-control centers.
7) Equipment control panels.

I. Signage: Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect.

J. 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

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Motors: Attach tag with chain to outside of motor or equipment.

END OF SECTION 260553

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.

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 entity 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 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 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.

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 and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

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: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    d. Generator kilovolt amperes, size, voltage, and source impedance.
    e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    f. Busway ampacity and impedance.
    g. 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, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

    a. Inrush current when first energized.
    b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. 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. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. 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 devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

   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.

F. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 260573

SECTION 262200 - LOW-VOLTAGE DISTRIBUTION 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.

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. This Section includes dry-type distribution transformers, rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: Include data on dimensions, weight, electrical ratings, impedance percentage, taps, insulation class, sound level, and minimum clearances. Include dimensioned plans, sections, and elevation views. Include wiring diagrams identifying terminals for tap changing and connecting field-installed wiring.

B. Qualification Data: For testing agency.

C. Field quality-control test reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1. Provide output voltages and tap settings.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain transformers through one source from a single manufacturer.

C. Comply with NFPA 70.

D. Comply with UL 1561.

E. Comply with Department of Energy (DOE) 2016 Transformer Efficiency Standards.

F. Comply with NEMA ST1-4 and ANSI C89.1 for sound levels.

G. Product Selection for Restricted Space: Drawings indicate maximum dimensions for transformers including clearances between transformers and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide wrapping, crate, pallet, support, bracing and other protection for transformers to prevent damage during handling, transit, delivery and storage.

B. Coordinate installation and delivery to minimize the amount of time for on-site storage.

C. 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.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Square D / Schneider Electric
1. ABB / General Electric
2. Siemens
3. Cutler-Hammer / Eaton
4. Powersmiths

2.2 GENERAL REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Enclosure: Ventilated enclosure complying with NEMA 250 for environment in which installed.

C. Taps: Full-capacity taps in high-voltage windings are as follows per transformer rating:

1. 3 kVA through 25 kVA: Two 5 percent taps below rated voltage.
2. 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below rated voltage.

D. K-Factor Rating: As indicated on Drawings. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor. Indicate value of K-factor on transformer nameplate.

E. Wall Brackets: Manufacturer's standard brackets for transformers up to 75 kVA.

2.3 DISTRIBUTION TRANSFORMERS

A. Coils: Aluminum or copper coils, one coil per phase in primary and secondary with continuous windings without splices, except for taps. Brazed or pressure type internal connections.

B. Insulation Class: 220 deg C insulation system with a maximum rated temperature rise of 150 deg C rise above 40 deg C ambient temperature.

C. Efficiency Requirements:

1. Single Phase Transformers

kVA rating	Efficiency % (min.)
15	97.70
25	98.00
37.5	98.20
50	98.30
75	98.50
100	98.60
167	98.70
250	98.80
333	98.90

2. Three Phase Transformers

kVA rating	Efficiency % (min.)
15	97.89
30	98.23
45	98.40
75	98.60
112.5	98.74

150	98.83
225	98.94

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Equipment Mounting: Unless noted otherwise, install transformer on concrete base.

C. Install transformers according to manufacturer's written instructions.

D. Arrange equipment to provide adequate spacing for working clearance and cooling air circulation.

E. Install transformers on rubber vibration isolation pads.

3.2 CONNECTIONS

A. Grounding: Refer to Drawings for separately derived systems. Comply with requirements of Division 26 Section "Grounding and Bonding."

B. Wiring: Provide compression lugs and connect wiring according to Division 26 Section "Low-Voltage Conductors and Cables."

3.3 IDENTIFICATION

A. Conductors, and nameplates and warning signs in accordance with Division 26 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

A. Testing: Perform field quality-control testing to ensure transformer is operational within industry and manufacturer's tolerances, and is suitable for energizing.
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Perform tests and inspections and prepare test reports.

C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Infrared Scanning: Perform the following infrared scan tests and inspections and prepare reports:

1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each transformer. Remove panels so joints and connections are accessible to portable scanner.
2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each transformer 11 months after date of Substantial Completion.
3. Instruments and Equipment:

    a. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

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 voltage conditions at secondary terminals as follows:

    1. Output voltages not to exceed nameplate voltage plus 10 percent and not be lower than nameplate voltage minus 3 percent at maximum load conditions.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings. Include report with field-quality test results and operation and maintenance data.

3.6 CLEANING

A. Upon completion of installation, inspect interior and exterior of transformers.

B. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

C. Vacuum interior dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. This Section includes service and distribution switchboards and associated auxiliary equipment, rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Power Metering" for utility company power metering and Owner's power metering.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, component, and accessory specified.

B. Shop Drawings: For each switchboard and related equipment, include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

1. Enclosure types for types other than NEMA 250, Type 1.
2. Bus configuration, current, and voltage ratings.
3. Short-circuit current withstand rating of switchboard.
4. Short-circuit current interrupting rating of overcurrent protective devices. Include UL listing for series rating of installed devices.
5. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Utility company metering provisions with indication of approval by utility company.
7. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Wiring diagrams for power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Comply with NEMA PB 2.

E. Comply with NFPA 70.

F. Comply with UL 891.

G. Comply with IEEE C62.41.2, NEMA LS 1, and UL 1449.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Store so condensation will not occur on or in switchboards. Provide temporary heaters as required to avoid condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.6 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction. Locate switchboard to meet installation tolerances.

1. Maintain required workspace clearances, suitable path for moving switchboard into place, and required clearances.
2. Verify clearance requirements and dimensions by field measurements.
3. Determine suitable path for moving switchboard into place considering project conditions.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 EXTRA MATERIALS

A. Surge Protective Devices: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: One of each size and type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Square D / Schneider Electric
2. ABB / General Electric
3. Siemens
4. Cutler-Hammer / Eaton

2.2 SWITCHBOARDS

A. Fabrication: Front-connected, front-accessible with fixed, individually mounted main device, group-mounted branch devices, and sections front- and rear-aligned. Equip with mounting brackets, bus connections, and necessary appurtenances for total available space. Enclosure NEMA rating as indicated on Drawings. Include the following options:

1. Ratings: Provide nominal system voltage, continuous main-bus amperage, and short-circuit ratings as indicated on Drawings.
2. Utility Metering: Compartment meeting utility company's requirements.
3. Owner Metering Compartment.
4. Bus transition and Incoming Line Pull Sections.
5. Buses: Copper bus , with full size neutral bus and removable bonding link , and copper equipment ground bus.
6. Hinged Front Panels.
7. Insulating barriers between sections.
8. Provisions for future extensions as indicated on Drawings.
9. 120V control power transformer with primary and secondary fuses.
10. Factory mounted Surge Protection Devices as indicated on Drawings.
11. Service Equipment Approval as indicated on Drawings.

2.3 MAIN OVERCURRENT PROTECTIVE DEVICE

A. Molded-Case Circuit Breaker: Field-adjustable short-time and continuous current settings. Frame size, trip rating, auxiliary devices, and interrupting rating as indicated on Drawings. Include the following options:

1. Current-limiting trip units with let-through ratings less than NEMA FU 1, Class RK-5 as indicated on Drawings.
2. Communication capability.
3. Ground-Fault protection.
4. Undervoltage trip.
5. Auxiliary contacts, form-C.
6. Key Interlock.
7. Zone-Selective Interlocking.
8. Arc-Flash Maintenance Switch
    a. Provide a manual switch on the compartment door to switch the circuit-breaker short-time tripping characteristics to instantaneous with minimum pickup setting, to reduce the danger from potential arc-flash at downstream equipment.
    b. Provide a lock feature for the switch so that it may be locked in either the off or on maintenance-mode position.
    c. Provide a blue LED indicating light to indicate that the switch is in maintenance mode.

B. Enclosed, Insulated-Case Power Circuit Breaker: Microprocessor-based trip unit with interchangeable rating plug, LED trip indicators, and field adjustable settings. Frame size, trip rating, number of poles, auxiliary devices, and interrupting rating as indicated on Drawings. Include the following options:
1. Fixedmounting.
2. LSIG units.
3. Communication capability.
4. Key Interlock.
5. Zone-Selective Interlocking.
6. Arc-Flash Maintenance Switch
    a. Provide a manual switch on the compartment door to switch the circuit-breaker short-time tripping characteristics to instantaneous with minimum pickup setting, to reduce the danger from potential arc-flash at downstream equipment.
    b. Provide a lock feature for the switch so that it may be locked in either the off or on maintenance-mode position.
    c. Provide a blue LED indicating light to indicate that the switch is in maintenance mode.

C. Fusible Switch: Class L fuses. Frame size, fuse rating, and interrupting rating as indicated on Drawings.

2.4 GROUP-MOUNTED OVERCURRENT PROTECTION DEVICES

A. Molded-Case Circuit Breakers: mechanical lugs, Type SWD and Type HACR as applicable, interchangeable trip units for frame sizes 200 A and greater, field-adjustable short-time and continuous current settings for frame sizes 400 A and greater. Common trip multipole breakers. Frame size, trip rating, number of poles, auxiliary devices, and interrupting rating as indicated on Drawings. Include the following options:

1. Current-limiting trip units with let-through ratings less than NEMA FU 1, Class RK-5 as indicated on Drawings.
2. Ground Fault Circuit Interrupter as indicated on Drawings.
3. Shunt trip units as indicated on Drawings.
4. Arc-Flash Maintenance Switch (for breakers with rating 1200A or greater).
    a. Provide a manual switch on the compartment door to switch the circuit-breaker short-time tripping characteristics to instantaneous with minimum pickup setting, to reduce the danger from potential arc-flash at downstream equipment.
    b. Provide a lock feature for the switch so that it may be locked in either the off or on maintenance-mode position.
    c. Provide a blue LED indicating light to indicate that the switch is in maintenance mode.

B. Enclosed, Insulated-Case Power Circuit Breakers: microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and field adjustable settings. Frame size, trip rating, number of poles, auxiliary devices, and interrupting rating as indicated on Drawings. Include the following options:

1. Fixedmounting.
2. LSIunits.
3. Communication capability.
4. Zone-Selective Interlocking.
5. Arc-Flash Maintenance Switch(for breakers with rating 1200A or greater).
    a. Provide a manual switch on the compartment door to switch the circuit-breaker short-time tripping characteristics to instantaneous with minimum pickup setting, to reduce the danger from potential arc-flash at downstream equipment.
    b. Provide a lock feature for the switch so that it may be locked in either the off or on maintenance-mode position.
    c. Provide a blue LED indicating light to indicate that the switch is in maintenance mode.

C. Fusible Switches, with mechanical lugs. Class J fuses for frame sizes 600 A or less, Class L fuses for frame sizes greater than 600 A. Frame size, fuse rating, number of poles, and interrupting rating as indicated on Drawings.

2.5 INSTRUMENTATION

A. Instrument Transformers: As required for relays, meters, and instruments.

2.6 SURGE PROTECTIVE DEVICE

1. Refer to section 264313.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards level and plumb on concrete base. Install according to manufacturer's written instructions and NEMA PB 2.1.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

C. Operating Instructions: Frame and mount printed basic operating instructions for switchboards, including emergency procedures. Provide metal frame with clear acrylic plastic cover. Mount adjacent to switchboards.

D. Install filler plates in unused spaces of panel-mounted sections.

3.3 CONNECTIONS

A. Comply with manufacturer's written instructions and Division 26 Section "Low-Voltage Conductors and Cables."

3.4 IDENTIFICATION

A. Identify field-installed conductors, wiring, overcurrent protection devices, and components, and provide warning signs complying with requirements in Division 26 Section "Electrical Identification."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 CLEANING

A. Upon completion of installation, inspect interior and exterior of switchboards.

B. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION 262413

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.

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. Section provides for panelboards and associated auxiliary equipment rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section "Power Metering" for Owner's power metering.

1.3 SUBMITTALS

A. Product Data: Submit complete product information for each type of panelboard, accessory item, and component specified.

B. Shop Drawings: Submit drawings for panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA 250, Type 1.
2. Bus configuration and current ratings.
3. Short-circuit current withstand rating of panelboard. Indicate series and/or fully rated devices.
4. Short-circuit current interrupting rating of overcurrent devices.
5. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
6. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.

C. Qualification Data: For qualified testing agency.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

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. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Comply with NECA Standards of Installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Square D / Schneider Electric
2. ABB / General Electric
3. Siemens
4. Cutler-Hammer / Eaton

2.2 DISTRIBUTION PANELBOARDS

A. Fabrication: Equip with mounting brackets, bus connections, and necessary appurtenances for total available space. Provide equipment ground bus bonded to box. Cabinet mounting, NEMA rating, and interior mains as indicated on Drawings. Arrange devices as indicated on drawings. Include the following options:

1. Trim without door.
2. Copper bus , with full size neutral bus, unless noted otherwise on Drawings.

3. Metal directory frame with transparent protective cover.
4. Mechanical type main lug interiors as indicated on Drawings.
5. Feed-through lugs as indicated on Drawings.
6. Extra gutter space as indicated on Drawings.
7. Fully rated short-circuit rating to available current indicated on Drawings.
8. Factory mounted Surge Protection Devices as indicated on Drawings.
9. Service Equipment Approval as indicated on Drawings.
10. Panel-mounted power meters as Indicated on Drawings.

B. Overcurrent Protective Devices: Molded-case circuit breakers, with mechanical lugs. Bolt-on type breakers for frame sizes less than 225 A, plug-in type breakers for frame sizes 225 A and greater. Type SWD and Type HACR as applicable. Ground Fault Circuit Interrupter as indicated on Drawings. Interchangeable trip units for frame sizes 200 A and greater. Field-adjustable short-time and continuous current settings for frame sizes 400 A and greater. Common trip multipole breakers. Frame size, trip rating, number of poles, auxiliary devices, and interrupting rating as indicated on Drawings. Include the following options:

1. Arc-Flash Maintenance Switch (for any device 1200A, or greater)
    a. Provide a manual switch on the compartment door to switch the circuit-breaker short-time tripping characteristics to instantaneous with minimum pickup setting, to reduce the danger from potential arc-flash at downstream equipment.
    b. Provide a lock feature for the switch so that it may be locked in either the off or on maintenance-mode position.
    c. Provide a blue LED indicating light to indicate that the switch is in maintenance mode.

C. Overcurrent Protective Devices: Fusible switches, with mechanical lugs. Class J fuses for frame sizes 600 A or less, Class L fuses for frame sizes greater than 600 A. Frame size, fuse rating, number of poles, and interrupting rating as indicated on Drawings.

2.3 PANELBOARDS

A. Fabrication: Equip with mounting brackets, bus connections, and necessary appurtenances for total available space. Provide equipment ground bus bonded to box. Cabinet mounting, NEMA rating, and interior mains as indicated on Drawings. Arrange devices as indicated on Drawings. Include the following options:

1. Front trim with concealed clamps.
2. Copper bus , with full size neutral bus, unless noted otherwise on Drawings.
3. Metal directory frame with transparent protective cover.
4. Mechanical type main lug interiors as indicated on Drawings.
5. Feed-through lugs as indicated on Drawings.
6. Extra gutter space as indicated on Drawings.
7. Fully rated to available short-circuit current indicated on Drawings.
8. Factory mounted Surge Protection Devices as indicated on Drawings.
9. Service Equipment Approval as indicated on Drawings.
10. Panel-mounted power meters as Indicated on Drawings.

B. Overcurrent Protective Devices: Molded-case circuit breakers, bolt-on type with mechanical lugs. Type SWD and Type HACR as applicable. Ground Fault Circuit Interrupter as indicated on Drawings. Common trip multipole breakers. Frame size, trip rating, number of poles, auxiliary devices, and interrupting rating as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mount panelboards plumb and rigid without distortion of box.

C. Mount panelboards at 72-inches above finished floor to top of panel.

D. Mount recessed panelboards uniformly flush with wall finish.

1. Stub four 1-inch empty conduits from panelboards into accessible ceiling space.

E. Install filler plates in unused spaces.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 CONNECTIONS

A. Comply with requirements in Division 26 Section "Low-Voltage Conductors and Cables."

B. Comply with requirements in Division 26 Section "Grounding and Bonding."

3.4 IDENTIFICATION

A. Conductors, wiring, and panelboard nameplates and warning signs in accordance with Division 26 Section "Electrical Identification."

B. Circuit Directory: Provide typed circuit schedules with explicit description and identification of items controlled by each individual breaker, stored in panelboard door frame.

3.5 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards.

B. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 262416

SECTION 262713 - POWER METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. Section includes equipment for utility company power metering and Owner's power metering.

B. Related Sections include the following:

1. Division 26 Section "Switchboards" for factory panel-mounting of metering equipment.
2. Division 26 Section "Panelboards" for factory panel-mounting of metering equipment.

1.3 SUBMITTALS

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

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: For power, signal, and control wiring, including recommended types, wire sizes, and circuiting arrangements for field-installed wiring.

C. Field quality-control reports.

D. Operation and Maintenance Data. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.

1.4 QUALITY ASSURANCE

A. Comply with requirements of electrical utility company.

B. Source Limitations: Obtain Owner meters, components, software, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for meters including clearances between meters and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Comply with NFPA 70.

E. Comply with UL 1244.

F. Comply with NECA 1.

1.5 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for one year.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within one year from date of Substantial Completion. Include new or revised licenses for use of software.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR UTILITY COMPANY POWER METERING

A. Equipment: Meters furnished by utility company . Current-transformers and sockets to comply with requirements of electrical utility company. Rated and configured for voltages, phases, ampacity, and short-circuits as indicated on Drawings.

2.2 EQUIPMENT FOR OWNER POWER METERING

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

1. Cutler-Hammer.
2. General Electric.
3. Siemens.
4. Square D.

B. Service Power Metering: Multifunction microprocessor-based unit with multi-line digital display keypad, status indicators, compatible current transformers, factory panel-mounted in service equipment, with internal current transformer termination and shorting and fuse block. Rated and configured for voltages, phases, ampacity, and short-circuits as indicated on Drawings. Self-contained memory backup to maintain memory throughout outages of 72 hours, minimum. Include the following monitoring capabilities:

1. Accuracy: Equal to or less than **[1.0 percent of reading] [0.2 percent of reading] [, revenue certifiable]**.
2. Voltage: Phase-to-phase, phase-to-neutral, and average.
3. Current: Each phase and average.
4. Power: kW, kVA, kVAR, and power factor for each phase and total.

5. Frequency: Maximum and minimum.
6. Hours: Total kW-h and kVA-h.
7. Demand: Peak demands for kW, kVA, kVAR, and power factor, with user adjustable time periods, calculated according to utility demand structure.
8. Harmonic Analysis.

C. Power Sub-Metering: Multifunction microprocessor-based unit with digital display, keypad, status indicators, compatible current transformers, [**factory panel-mounted in panelboard**] [**cabinet mounted with enclosure NEMA rating as indicated on Drawings, with hasp for padlocking**]. Rated and configured for voltages, phases, ampacity, and short-circuits as indicated on Drawings. Self-contained memory backup to maintain memory throughout outages of 72 hours, minimum. Include the following monitoring capabilities:

1. Minimum Accuracy: **[1.0 percent of reading] [0.2 percent of reading, revenue certifiable]**.
2. Voltage: Phase-to-phase, phase-to-neutral, and average.
3. Current: Each phase and average.
4. Power: kW, kVA, kVAR, and power factor for each phase and total.
5. Frequency: Maximum and minimum.
6. Hours: Total kW-h and kVA-h.

D. Communication: Include the following communication capabilities for metering equipment.

1. Serial Network: Integral RS-485 open communication protocol with ability to daisy-chain multiple meters and connect to a remote personal computer.
2. Local Communication: Integral Infrared data association port in face of meter.
3. Ethernet: Ethernet port for communication over Local Area Network (LAN) using TCP/IP.

E. Software: Include personal computer based software compatible with meters for remote monitoring, waveform recording, and meter configuration. Include one license. Include security features to prevent unauthorized access. Include applications with the following features:

1. Start-up and Maintenance: For configuration, adjustment, and maintenance of meters.
2. Monitoring: For ability to monitor individual meters over the network.
3. Data Recording: To create historical records of events and trends for meters and save data to personal computer.
4. Reporting: For ability to produce, view, and print user reports on monitored quantities and trends.
5. Alarms: User setpoints on monitored quantities or events with ability to send alarms via visual, audio, and email notification.
6. Billing and Cost Allocation: Automatically import energy-usage records to allocate energy costs for the <**insert number**> [**departments**] [**tenants**] [**processes**] [**buildings**]

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

B. Install cabinet mounted meters for Owner metering according to manufacturer's written instructions.

1. Mount cabinets plumb and rigid without distortion of box.
2. Mount cabinets at 72-inches above finished floor to top of panel.

C. Arrange conductors in gutters into groups and bundle and wrap with wire ties. Bundle current transformer wiring separately from power conductors.

3.2 CONNECTIONS

A. Comply with requirements in Division 26 Section "Low-Voltage Conductors and Cables."

B. Comply with requirements in Division 26 Section "Grounding and Bonding."

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to provide startup service and software configuration, including adjusting and inspecting components, connections, assemblies, and equipment installations, and to assist in testing.

B. Tests and Inspections:

1. Connect a load of known kilowatt rating, sized as recommended by manufacturer, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Prepare test and inspection reports.

3.5 CLEANING

A. Upon completion of installation, inspect interior and exterior of metering cabinets.

B. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.6 DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to demonstrate equipment, software, and train Owner's maintenance personnel.

END OF SECTION 262713

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.

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. This Section includes receptacles, switches, wall plates, cord connections .

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

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

B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Comply with NFPA 70.

C. Comply with NEMA WD 1.

D. Comply with NEMA WD 6 and UL 498.

E. Comply with UL 20.

F. Comply with UL 943.

PART 2 - PRODUCTS

2.1 DEVICES

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

1. Cooper Wiring Devices.
2. Hubbell Wiring Device-Kellems.
3. Leviton Manufacturing.
4. Pass & Seymour.

B. Straight-Blade Receptacles: 125 V, 20 A, grounding type, NEMA 5-20R, back and side wired.

1. Single Receptacles: Heavy-duty, specification-grade.

2. Duplex Receptacles: Heavy-duty, specification-grade with types, or combinations thereof, as indicated on Drawings.

a. GFCI: Personnel protection, feed-through, with indicator light for protection status.
b. Isolated-Ground: Grounding screw terminal electrically isolated from mounting strap for equipment ground connections.
c. Tamper-Resistant: Integral dual mechanical shutter system to help prevent insertion of foreign objects.
d. Weather-Resistant (WR): Additional protection against accelerated aging, cold impact, corrosion, and ultraviolet light exposure. Provide WR devices for all exterior 15A and 20A devices.

3. Twist-Locking Receptacles: Single receptacles, heavy-duty, industrial-grade, grounding type, with voltage ratings, amperage ratings, and NEMA configuration as indicated on Drawings.

a. Isolated-Ground: Grounding screw terminal electrically isolated from mounting strap for equipment ground connections.

4. Combination USB/Receptacle Devices: Single receptacle with (2) built in USB Charger.

a. USB ports shall be capable of charging two devices simultaneously.

C. Switches: 120/277 V, 20 A, heavy-duty, quiet-type, specification-grade, grounding type, modular connection with pre-wired pigtails or back and side wired.

1. Snap Switches: Toggle switch, with number of poles, switching configuration types, or combinations thereof, as indicated on Drawings.

a. Pilot Light Switches: Illuminated when switch is on.

2. Key-Operated Switches: Factory-supplied key in lieu of switch handle with number of poles, switching configuration types, or combinations thereof, as indicated on Drawings.

3. Three-Position Switches: Single-pole, double-throw, maintained contact, center-off.

D. Wall Plates: Standard-size single and combination types to match corresponding wiring devices. Plate-securing metal screws with head color matching plate finish.

1. Finished Spaces: Metal, 302 stainless steel finish.
2. Unfinished Spaces: Metal, 302 stainless steel finish.
3. Damp Locations: Listed, cast aluminum with spring-loaded lift cover.
4. Wet Locations: Listed, cast aluminum weatherproof in-use cover, NEMA type 3R, with lockable cover.

E. Finishes: Colors as specified, unless otherwise indicated or required by NFPA 70 or device listing.

1. Connected to Normal Power System: White .
2. Connected to Emergency Power System: Red.

2.2 CORD AND PLUG SETS

A. Description: Type SOW cord, with nylon body plug with cable-clamping jaws. Voltage ratings, current ratings, and number of conductors matched to requirements of equipment being connected.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

B. Install devicesplumb, level, and secured tight to mounting surface. Repair wall finishes when standard device plates do not fit flush or do not cover rough wall opening.

C. Protect devices during painting. Install wall plates after painting is complete.

D. Dimmers: Install dimmers within terms of their listing and according to manufacturer's written instructions. Derate for ganging as required. Do not share neutral conductor on load side.

E. Coordinate locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

F. Provide Tamper-resistance receptacles as indicated on the plans.

3.2 CONNECTIONS

A. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor and to outlet box with bonding jumper.

C. Isolated-Ground Receptacles: Connect wiring device grounding terminal to isolated-ground conductor.

D. Tighten unused terminal screws on the device.

3.3 FIELD QUALITY CONTROL

A. Tests wiring devices for proper polarity and ground continuity. Operate each device a minimum of six times.

B. Test GFCI receptacle operation according to manufacturer's written instructions.

C. Replace damaged or defective components.

3.4 CLEANING

A. Prior to installation of devices, clean interior of outlet boxes and assembly enclosures.

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.

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. Section includes fuses rated 600V or less, and fuses rated over 600V.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and time-current coordination curves.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain from one source from single manufacturer.

B. Comply with NFPA 70.

C. Comply with NEMA FU 1.

1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 20 percent of quantity installed for each size and type, but no fewer than 1 set of 3 of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Bussmann.
2. Ferraz Shawmut.
3. Littelfuse.

2.2 FUSES RATED 600V OR LESS

A. Characteristics: Nonrenewable cartridge fuses with ampacity and voltage ratings consistent with Drawings.

B. 601 Ampere or Larger: Class L, fast acting.

C. 600 Ampere or Less: Class J, time delay.

2.3 FUSES RATED OVER 600V

A. Characteristics: Nonrenewable barrel fuses with ampacity and voltage ratings consistent with Drawings.

B. Transformer and Feeder Protection: E-rated, current limiting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fuses in fusible devices as indicated. Arrange so ratings are readable without removal.

B. Provide spare fuse cabinet in main electrical room with spare fuses.

3.3 IDENTIFICATION

A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES

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.

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. Section includes individually mounted enclosed switches for fusible switches and non-fusible switches.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed switch, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, enclosure types, performance, electrical characteristics, ratings, accessories, and finishes.

1. Include time-current coordination curves for each type and rating of overcurrent protective device.

B. Operation and Maintenance Data: For enclosed switches to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches from one source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Comply with NFPA 70.

D. Comply with NEMA KS 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Square D / Schneider Electric
2. ABB / General Electric
3. Siemens
4. Cutler-Hammer / Eaton

2.2 DISCONNECT SWITCHES

A. Switch Characteristics: Type HD, heavy duty with voltage ratings, frame sizes, fuse/trip ratings, number of poles, interrupting/withstand ratings, and accessories as indicated on Drawings.

B. Fusible Switches: Clips to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Non-fusible Switches: Lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Enclosures
1. Nema 1 for Indoor Locations (Except for Kitchens)
2. Nema 3R for Exterior Locations
3. Nema 4X – Stainless Steel for Kitchens

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit, where indicated on Drawings: Auxiliary contact(s), arranged to activate before switch blades open.

2.3 MOTOR RATED TOGGLE SWITCHES

A. Toggle Switch
1. Coordinate electrical characteristics with serving equipment
   a. Voltage: 120V, 240V, or 600V – Match Serving Electrical Service
   b. Rating: 20A, 30A, or 40A – Match Serving Circuit Breaker
   c. Poles: 1, 2, or 3 – Coordinate with Serving Electrical Service
2. Provide with clip for lockout/tagout hasp.

B. Enclosures
1. Nema 1 for Indoor Locations (Except for Kitchens)
2. Nema 3R for Exterior Locations
3. Nema 4X – Stainless Steel for Kitchens

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual switches level and plumb, with tops at uniform height, unless otherwise indicated. Install according to manufacturer's written instructions.

B. Install fuses in fusible switches.

C. Connect switches and components to wiring system according to by manufacturer's written instructions and Division 26 Section "Low-Voltage Conductors and Cables."

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

A. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

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

3.6 CLEANING

A. After completing system installation, remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCP: Motor circuit protector.

C. N.C.: Normally closed.

D. N.O.: Normally open.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

    a. Each installed unit's type and details.
    b. Factory-installed devices.
    c. Nameplate legends.
    d. Short-circuit current rating of integrated unit.
    e. Features, characteristics, ratings, and factory settings of individual MCPs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.

3. Manufacturer's written instructions for setting field-adjustable overload relays.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 STARTERS

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

1. Allen-Bradley.
2. Square D / Schneider Electric
3. ABB / General Electric
4. Siemens
5. Cutler-Hammer / Eaton

B. General Requirements: Comply with NEMA ICS 2, general purpose, Class A. Non-reversing. Melting alloy type overload relays, with inverse-time-current characteristics, and with heaters matched to nameplate full-load current of actual protected motor. External reset push button. Enclosure type and mounting as indicated on Drawings. Include the following options:
1. Surge Suppressor
2. LED Indicator Lights – Start/Stop
3. Hand-Off-Auto Selector Switch
4. Test pushbutton
5. Under voltage Relay
6. Phase-failure Relay
7. Control transformer (24VAC)

C. Manual Controllers: Toggle switch; marked to show whether unit is off, on, or tripped. Red pilot light.

D. Combination Magnetic Controllers: Factory-assembled combination of magnetic controller, MCP, and disconnecting means. Full voltage, across the line, electrically held. Circuit breaker, starter size, and control voltage as indicated on Drawings. Control transformer of of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices, with 50 VA spare capacity. Totally enclosed double break bower contacts.

1. MCP Disconnecting Means: UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

E. Accessories: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated. LED type pilot lights, colors as indicated on Drawings. Rotary type selector switches. Auxiliary contacts as indicated on Drawings.

F. Enclosures
1. Nema 1 for Indoor Locations (Except for Kitchens)
2. Nema 3R for Exterior Locations
3. Nema 4X – Stainless Steel for Kitchens

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall.

B. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

C. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test each motor for proper phase rotation.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 262913

SECTION 264313 - TRANSIENT-VOLTAGE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The other Contract Documents complement this Section.

1.2 SUMMARY

A. Section includes field-mounted TVSS for low-voltage power distribution and control equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

B. Operation and maintenance data.

C. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

C. Comply with NEMA LS-1.

D. Comply with UL 1449.

E. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SUPPRESSOR REQUIREMENTS

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

1. Cutler-Hammer (Eaton Electrical Inc.)
2. General Electric Company.
3. Siemens.
4. Square D; (Schneider Electric).

B. Surge Protection Devices:

1. Integral to Electrical Equipment or External Mounted
2. Modular.
3. LED indicator lights for power and protection status.
4. Fuses, rated at interrupting capacity as adjacent panel/equipment.
5. Fabrication using bolted compression lugs for internal wiring.
6. LED indicator lights for power and protection status.

C. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2

1. Line to Neutral: 70,000 A.
2. Line to Ground: 70,000 A.
3. Neutral to Ground: 50,000 A.

D. Protection modes and UL 1449 SVR:

1. 480/277 V, three-phase, 4-wire circuits:
   a. Line to Neutral: 800V.
   b. Line to Ground: 800V.
   c. Neutral to Ground: 800V.
2. 208/120 V, three-phase, 4-wire circuits:
   a. Line to Neutral: 400V.
   b. Line to Ground: 400V.
   c. Neutral to Ground: 400V.
3. 240/120 V, single-phase, 3-wire circuits:
   a. Line to Neutral: 400V.
   b. Line to Ground: 400V.
   c. Neutral to Ground: 400V.

2.2 SURGE-CURRENT RATING

A. Peak Single-Impulse Surge Current Rating:

1. Service Entrance Equipment – 240 kA per phase.
2. Panelboard – 160 kA per phase.
3. Device - – 50 kA per phase.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

1. Provide multiple, circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup checks according to manufacturer's written instructions.

C. TVSS device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Do not energize or connect service entrance equipment to their sources until TVSS devices are installed and connected.

B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION 264313

SECTION 265000 - 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.

B. The other Contract Documents complement this section.

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, light engine, power supply, and accessories.
2. Exterior lighting fixtures, light engine, power supply, and accessories.
3. Emergency lighting units.
4. Exit signs.

1.3 DEFINITIONS

A. Fixture: Complete lighting fixture, emergency lighting unit, or exit sign.

1. Fixtures include light engine, power supply, parts, and accessories for light distribution, positioning and protecting components, support, and connection to power supply.
2. Exit signs and emergency lighting units with battery power include the internal battery with means of controlling and charging.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include complete data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Power Supply including actual wattage and control wiring.
4. Light Engine, including rated average life, initial lumens, mean lumens, correlated color temperature, color-rendering index, and mercury content.
5. Photometric data and adjustment factors based on independent laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type.

B. Field quality-control reports.

C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals specified in Division 01.

1. Provide a list of all lamp and light engine types used on Project; use ANSI and manufacturers' codes.
2. Provide a list of all power supply types used on Project with manufacturers' codes.

1.5 QUALITY ASSURANCE

A. 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, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

B. Comply with NFPA 70.

C. Comply with UL 1598 for fixtures.

D. Comply with UL 924 for exit signs, emergency lighting units, and emergency power supplies.

E. Comply with UL 844 for explosion-proof fixtures.

F. Comply with UL 1574 for track lighting.

G. Comply with UL 1598 for Solid state lighting (LED).

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Light Engines and Driver: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Emergency battery pack: One for every 50 of each type and rating installed. Furnish at least one of each type.
4. Power Supply: One for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 LIGHT FIXTURES

A. Products: For each fixture type, subject to compliance with requirements, provide product indicated in the Lighting Fixture Schedule on Drawings or comparable product by one of the other manufacturers specified on the schedule.

B. Finishes: Standard, except as otherwise indicated, applied over corrosion-resistant treatment or primer, free of streaks, runs, holidays, stains, blisters, and similar defects.

1. Where note “standard color selected by Architect” is included in the fixture schedule. Color samples for standard colors shall be submitted for review and selection by Architect.
2. Where note “custom color selected by Architect” is included in the fixture schedule. Custom RAL color samples shall be submitted for review and selection by Architect.

C. Solid State Lighting (LED Luminaires):

1. Comply with IES LM-79.
2. CRI 75 (minimum).
3. Color consistency comply with NEMA SSL 3.
4. B70 rating at least 50,000 hours per IES LM-80.

2.2 LED DRIVERS

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

1. Philips Advance.
2. General Electric.
3. Osram Sylvania.
4. Universal Lighting Technologies.

B. Requirements.

1. Electronic Type – with sound rating “A”.
2. Comply with NEMA SSL-1.
3. Minimum Efficiency – 85%
4. Total Harmonic Distortion (THD) – less than 20%
5. Dimming – 0-10V type. Down to 10%, unless otherwise noted on the schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount or install fixtures level, plumb, and square with ceilings and walls. Secure according to manufacturer's written instructions and approved Shop Drawings. Install lamps.

B. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture 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.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Give advance notice of dates and times for field tests.

C. Test for Emergency Lighting: Interrupt normal power supply to demonstrate proper operation. Verify transfer from normal power to emergency power source and retransfer to normal. Replace and repair malfunctioning fixtures and components and retest until all fixtures operate properly.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.3 CLEANING

A. Clean fixtures after installation using materials and methods recommended by manufacturer. Protect fixtures from dirt and debris during remainder of construction.

B. Immediately prior to final inspection, for Substantial Completion, clean fixtures Inspect, adjust, repair, replace, and re-clean fixtures to meet requirements.

END OF SECTION 265000