

PROJECT MANUAL

Project:

Niagara University Academic Innovation Hub Workforce Development Training

822 Cleveland Avenue | Niagara Falls, New York 14305

Owner:



5795 Lewiston Road | Niagara University, New York 14109

Architect:



300 Pearl Street | Suite 130 | Buffalo, NY 14202 | 716.551.6281



**Empire State
Development**

ESD PROJECT No. 135.035



HUD PROJECT No. B-23-CP-NY-1083

April 11, 2024
LaBella Project No. 2221723
EDA PROJECT No. 01-01-15369

Bid Submission
Volume 1 of 2 - Divisions 00-14



Exp. 7/31/2024

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Volume 2 of 2 - Divisions 21-33



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NIAGARA UNIVERSITY
ADVERTISEMENT FOR BIDS
For
**ACADEMIC INNOVATION HUB
WORK FORCE DEVELOPMENT TRAINING**
822 CLEVELAND AVENUE, NIAGARA FALLS, NY 14305

ESD PROJECT NO. 135,035
HUD PROJECT NO. B-23-CP-NY-1083
EDA PROJECT NO. 01-01-15369

Single sealed bids for General Construction work for the above project will be received by Niagara University at 21 University Drive, Niagara University, New York 14109 until 2:00 PM local time on Thursday May 16, 2024, at which time they will be opened and read aloud. This project is grant funded by Empire State Development (ESD), U.S Department of Housing and Urban Development (HUD) and Economic Development Agency (EDA) and shall meet all state and federal requirements outlined in the bid documents. In addition, the Niagara Falls Historic Preservation Commission as well as the State Historic Preservation Office (SHPO) consider the existing building historically significant and therefore rehabilitation work shall comply with the Secretary of the Interior's Standards for the Treatment of Historic Properties.

Issue for Bid: Thursday April 18, 2024
Mandatory Pre-Bid Meeting: Thursday April 25, 2024
Bid Due Date: Thursday May 16, 2024 - 2:00 PM Local Time
Projected Award Date: Week of May 20, 2024

INVITATION TO BID:

NIAGARA UNIVERSITY

Academic Innovation Hub
Work Force Development Training

822 Cleveland Avenue
Niagara Falls, New York 14305

Notice is hereby given that Niagara University, Niagara University, New York, will receive sealed proposals for the Academic Innovation Hub- Work Force Development Training

All work shall be done in accordance with drawings and specifications prepared by LaBella Associates. All bidders shall be expected to keep prices bid firm for 90 days from date of bid opening, during which time the Owner will be able to make awards therein.

The Owner (hereinafter referred to as Owner):

Niagara University
Facility Services Department
11 Vincentian Drive, P.O. Box 2033
Niagara University, New York 14109

And the Architect (hereinafter referred to as Architect or A/E):

LaBella Associates DPC
300 Pearl Street, Suite 130
Buffalo, New York 14202

1. ISSUE DATE: April 18, 2024

2. PRE-BID MEETING

- A. A mandatory "Pre-Bid Meeting" will be held on **Thursday, April 25, 2024 at 9:00 AM** at 822 Cleveland Avenue, Niagara Falls, New York 14305. Representatives of Architect and Owner will be in attendance.

3. BID PROPOSAL DUE DATE/ LOCATION

- A. Sealed proposals shall be brought to Niagara University Facility Services Office #101A on **Thursday May 16, 2024 by 2:00 PM EST.**

21 University Drive
Niagara University, New York 14109

4. BID DOCUMENT AVAILABILITY

- A. Bid documents, drawings and specifications are available at the following:

- i. Avalon (Buffalo Service)
40 La Riviere Drive, Suite 150
Buffalo, NY 14202
www.avalonbuff-planroom.com
Tel: 716-995-7777
Fax: 716-995-7778

- ii. Construction Exchange of Buffalo
2660 William Street
Cheektowaga, New York 14227
www.conexbuff.com/online-plan-room/
Tel: 716-874-3435
Fax: 716-875-4412
- iii. Builders Exchange (Rochester)
180 Linden Oaks, Suite 100
Rochester, New York 14625
www.robex.com/planroom/
Tel: 585-586-5460
- iv. Dodge Data
830 3rd. Avenue, 6th Floor
New York, New York 10022
Tel: 413-376-7032
- v. ConstructConnect
30 Technology Parkway South, Suite 100
Norcross, Georgia 30092
Tel: 302-602-5079
Fax: 302-602-5079
- vi. LaBella Associates DPC
300 Pearl Street, Suite 130
Buffalo, New York 14202
JRudniski@labellapc.com
Tel: 716-931-6510

5. SCHEDULE

- A. Invitation to Bid Published: April 18, 2024
- B. Bid Documents Available: April 18, 2024
- C. Mandatory Pre-Bid Meeting: April 25, 2024
- D. RFI Cut Off: May 7, 2024
- E. Bid Due Date: May 16, 2024
- F. Award Contracts: Week of May 20, 2024
- G. Construction Starts: June 10, 2024
- H. Substantial Completion: February 10, 2025

6. PROJECT SUMMARY

- A. Bids will be accepted by the Owner for the Academic Innovation Hub Work Force Development Training as described in this Invitation to Bid and the attached AIA Document A101-2017 and AIA A201-2017 General Conditions, as amended by Niagara University (NU).
- B. This project is funded my multiple funding agencies and will require compliance with all agency requirements as indicated in the bid documents
 - i. Empire State Development (ESD Project No. 135-035)- Downtown Revitalization Initiative Grant

- ii. U.S. Department of Housing and Urban Development (HUD Project No. B-23-CP-NY-1083)-
- iii. Economic Development Administration (EDA Project No. 01-01-15369)
 - 1. Federal Participation Disclosure: This Project will be partially funded with Federal funds from the United States Department of Commerce, Economic Development Administration and is therefore subject to the Federal laws and regulations associated with that program.
 - 2. Compliance with EDA Contracting Provisions for Construction Projects
 - 3. Compliance with EDA Certification Regarding Lobbying Lower Tier Covered Transactions (Form CD-512)
 - 4. Compliance with EDA Notice of Requirements for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246 and 41 CFR Part 60-4)
 - 5. Compliance with EDA Sign Requirements
- c. The project includes but not limited to:
 - i. Historical rehabilitation of the interior and exterior elements. The Niagara Falls Historic Preservation Commission as well as the State Historic Preservation Office (SHPO) consider the existing building historically significant and therefore rehabilitation work shall comply with the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR Part 68, 1995).
 - ii. The proposed work includes both exterior and interior rehabilitation for general construction, mechanical, electrical, plumbing and fire protection. Majority of the work will occur in the lower level (basement), rear of main floor and exterior. The existing main floor "former sanctuary space" will remain as is unless indicated per the drawings.
 - iii. Please refer to drawings and specifications prepared by LaBella Associates dated April 11, 2024 for a complete scope of work.

7. GENERAL REQUIREMENTS

- A. Upon receipt of Bid Documents verify that documents are complete.
- B. Immediately notify the Owner AND Architect in writing upon finding discrepancies or omissions in the Bid Documents.
- C. Bid Documents are made available only for the purpose of obtaining offers for this project. Their use does not grant a license for other purposes.
- D. This project is State of New York Sales Tax Exempt to the limits provided by law.
- E. Worker's Compensation Insurance, Public Liability Insurance and Builder's Risk Insurance is required to be maintained by the contractor and all subcontractors. See insurance requirements included in the bid documents.
- F. Bids shall include prevailing Davis Bacon wage rate determination- see bid documents
- G. Bidders will be required to provide bid security in the form of a Bid Bond for 5% of their entire bid amount. The successful bidder will also be required to furnish performance, labor, and material payment bonds equal to 100% of the contract price. Surety companies must be listed on Circular 570.
- H. Bidders are encouraged to utilize the service of minority and women owned subcontractors where possible in the pursuance of the project. Goals set forth for this project are outlined in the bid documents.
- I. This project will be constructed under a unified contract held by the General Contractor with the Owner, which will include all construction trades required to complete the work as shown and specified in the contract documents. Segregated Bids will not be accepted.
- J. Amendments to the submitted offer will be permitted if received in writing prior to bid closing and if endorsed by the same party or parties who signed and sealed the offer.
- K. The following must be submitted with the bid proposal:
 - i. Bid Proposal form and specified required proposal attachments.
 - ii. M/WBE Utilization Plan.

- iii. Preliminary List of major subcontractors, vendors and material suppliers.
- iv. Preliminary proposed schedule coordinated with the Contract Documents.

Niagara University reserves the right to reject or waive any or all bids and to advertise anew, and to award a contract for the whole or such portion of the work as it determines to be in the best interest of the University.

Any and all questions in regards to the meaning of the plans, specifications, or other contract documents will not be made verbally. All requests for such information should be made in writing using the Request For Information (RFI) form provided in specification Division 00 to LaBella Associates – Joseph Rudniski at JRudniski@labellapc.com and copy Dan McMann (Niagara University) at dmcmann@niagara.edu.

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

A. AIA Document A701, "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.

1. A copy of AIA Document A701, "Instructions to Bidders," is bound in this Project Manual.

END OF DOCUMENT 002113

DRAFT AIA® Document A701™ - 2018

Instructions to Bidders

for the following Project:

(Name, location, and detailed description)

Academic Innovation Hub – Work Force Development Training
822 Cleveland Avenue
Niagara Falls, New York 14305

THE OWNER:

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

Niagara University
11 Vincentian Drive, P.O. Box 2033
Niagara University, New York 14109

THE ARCHITECT:

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

LaBella Associates DPC
300 Pearl Street, Suite 130
Buffalo, New York 14202

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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.

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.

§ 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.)

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

§ 4.2.3 If a surety bond is required as bid security, it shall be written on AIA Document A310™, Bid Bond, unless otherwise provided in the Bidding Documents. The attorney-in-fact who executes the bond on behalf of the surety shall

affix to the bond a certified and current copy of an acceptable power of attorney. The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

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

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated below:

(Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)

« »

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

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

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

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

§ 4.4 Modification or Withdrawal of Bid

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

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

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

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

« »

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

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

§ 5.2 Rejection of Bids

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

§ 5.3 Acceptance of Bid (Award)

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

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

ARTICLE 6 POST-BID INFORMATION

§ 6.1 Contractor's Qualification Statement

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

§ 6.2 Owner's Financial Capability

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

§ 6.3 Submittals

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

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

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

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

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

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 Bond Requirements

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.

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

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

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of the Contract Sum.

(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)

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§ 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.)

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- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds, unless otherwise stated below.

(Insert the complete AIA Document number, including year, and Document title.)

<< >>

- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction, unless otherwise stated below.

(Insert the complete AIA Document number, including year, and Document title.)

<< >>

- .4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:

(Insert the date of the E203-2013.)

<< >>

- .5 Drawings

Number

Title

Date

- .6 Specifications

Section

Title

Date

Pages

.7 Addenda:

Number	Date	Pages

.8 Other Exhibits:

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

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

[] The Sustainability Plan:

Title	Date	Pages

[] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents listed below:

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

DOCUMENT 002213 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

1.1 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, GENERAL

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

1.2 ARTICLE 3 - BIDDING DOCUMENTS

A. 3.1 – Distribution:

1. Delete Section 3.1.2 and replace with the following:
 - a. No bid deposit is required.

B. 3.3 - Substitutions:

1. Delete Sections 3.3.1 through 3.3.4 and replace with the following:
 - a. 3.3.1 EQUIVALENCY CLAUSE: Where in these specifications certain kinds, types, brands or manufacturers of materials are named, they shall be regarded as the standard of quality. Where two or more are named, these are presumed to be equal, and the Contractor may select one of those items. If substitutions are to be proposed, the Bid or Proposal Package must contain a list of all proposed substitutions drawn in the form of sample "Substitution Sheet" included in the Bid or Proposal sample forms issued to all bidders. Each bidder shall list, in accordance with Specification Sections, all materials, products or equipment he proposes to offer as possible substitutions for specified items.
 - b. 3.3.2.1 After receipt of bids, the three (3) lowest bidders will be requested to submit required back-up data including "Request for Substitution Form" attached to the end of this section, for each proposed substitution for consideration of the Architect. Back-up data must be submitted to the Architect within three (3) working days of receipt of request by these bidders.
 - c. 3.3.4 No additional substitutions will be considered after this initial process unless substitution is required due to a specified material, product or equipment being removed from or made unavailable in the market place. Upon such circumstances, additional substitutions will be considered by the Architect, but only at no change to or at a reduction/credit to the Contract amount.
 - d. All substitution proposals must comply with the criteria established in paragraph 3.4.3 of the Supplementary Conditions."

C. 3.4 Addenda:

1. Add the following to paragraph 3.4.1:
 - a. Failure of any bidder to receive addenda shall not relieve such bidder from any obligation under his bid as submitted.

1.3 ARTICLE 4 - BIDDING PROCEDURES

A. 4.4 Modification or Withdrawal of Bid

1. Paragraph 4.4.1, second line: After “Bids entirely” add “except as may be permitted by law.”

1.4 ARTICLE 5 – CONSIDERATION OF BIDS

- A. Change the following “Article 5 – Consideration of Bids”
 1. Paragraph 5.1: Opening of Bids shall read “Bids will be publicly opened.”

1.5 ARTICLE 6 – POST-BID INFORMATION

- A. 6.3 - Submittals:
 1. Paragraph 6.3.1: Delete in its entirety and replace with the following:
 - a. 6.3.1. - The Bidder shall, within three (3) working days of receipt of notice that he is one of the three (3) lowest bidders, submit the following information to the Owner through the Architect in writing:
 - 1) .1 A designation of the work to be performed by the Bidder with his own forces;
 - 2) .2 A list of names of Subcontractors or other persons or entities proposed to provide materials, products or equipment and perform portions of the work;
 - 3) .3 All back-up data to substantiate acceptability of materials, products, or equipment proposed as substitutions for specified items."

1.6 ARTICLE 7 – PERFORMANCE BOND AND PAYMENT BOND

- A. 7.1 – Bond Requirements:
 1. Paragraph 7.1.1: Performance and Payment Bonds are required. The cost shall be included in the Base Bid.

1.7 ARTICLE 8 – ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

- A. Delete Sections 8.1.2 through 8.1.4.

END OF DOCUMENT 00 2213

DOCUMENT 003126 - EXISTING HAZARDOUS MATERIAL INFORMATION

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. An existing Pre-renovation asbestos, lead-based paint and PCB inspection report for Project, prepared by Stohl Environmental, dated April 10, 2020, is available for viewing as appended to this Document.
- C. Related Requirements:
 - 1. Section 024116 "Structure Demolition" for notification requirements if materials suspected of containing hazardous materials are encountered.
 - 2. Section 024119 "Selective Structure Demolition" for notification requirements if materials suspected of containing hazardous materials are encountered.

END OF DOCUMENT 003126

DOCUMENT 003132 – VAPOR INTRUSION INFORMATION

1.1 VAPOR INTRUSION INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. A Vapor intrusion Assessment report for Project, prepared by LaBella Associates, dated June 14, 2023, is available for viewing as appended to this Document.
- C. Related Requirements:
 - 1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF DOCUMENT 003132

June 14, 2023

Mr. Daniel McMann
Niagara University, Facility Services
Physical Plant Room 101B-A
Niagara Falls, New York 14109

Re: Vapor Intrusion Assessment
822 Cleveland Avenue, Niagara Falls, New York
LaBella Project No. 2221723

Dear Mr. Carley:

LaBella Associates, D.P.C. (“LaBella”) completed a Vapor Intrusion Assessment (VIA) for the property addressed as 822 Cleveland Avenue, Niagara Falls, Niagara County, New York (Figure 1), hereinafter referred to as the “Site”. The VIA was performed in conformance with the scope of work outlined in the authorized agreement (P2303082) dated May 12, 2023.

INTRODUCTION

It is LaBella’s understanding that the Client desired to perform a VIA to evaluate the sub-slab soil vapor and indoor air associated with the Site Building located at 822 Cleveland Avenue.

FIELD INVESTIGATION

Vapor Intrusion Assessment

On May 25, 2023, sub-slab soil vapor samples [SS-1 and SS-2] were collected from the Site Building basement and corresponding indoor air samples [IA-1 and IA-2] were collected within the immediate vicinity of the sub-slab soil vapor samples. An outdoor ambient air sample (OA-1) was collected to the south, proximate and upwind of Site Building. The approximate locations of the air samples are depicted on Figure 2.

The sub-slab soil vapor samples, indoor air samples, and outdoor air sample were collected in laboratory certified summa canisters equipped with laboratory calibrated regulators to allow for the collection of samples over an approximate eight-hour period. The sub-slab soil vapor, indoor air and outdoor air samples were submitted for laboratory analysis of volatile organic compounds (VOCs) via United States Environmental Protection Agency (USEPA) Method TO-15. A New York State Department of Health (NYSDOH) Indoor Air Quality Questionnaire and Building Inventory was completed in accordance with NYSDOH Guidance Document for the Site Buildings included in the assessment. The sub-slab soil vapor, indoor air and outdoor air sampling logs and the NYSDOH Indoor Air Quality Questionnaire and Building Inventories are included in Attachment 1.

LABORATORY ANALYTICAL RESULTS

The sub-slab and indoor air sample results were compared to the 2006 NYSDOH Guidance Document, including subsequent updates. The document provides guidance values for several compounds in the form of Decision Matrices and Air Guideline Values. For compounds without specific guidance values, typical background levels are used for comparison purposes. The NYSDOH Soil Vapor Intrusion Guidance Appendix C, includes a USEPA 2001 Building Assessment and Survey Evaluation (BASE) Database which provides a database of data collected from buildings for comparison purposes. For the purposes of this evaluation, the 90th percentile values were utilized for comparison. It should be noted that this database is referenced to provide a relative benchmark for comparison to the indoor air sampling data but does not represent regulatory standards or compliance values.



Based on the laboratory analytical results, several compounds were detected in each of the samples collected from sub-slab soil vapor, indoor air, and outdoor air, above laboratory method detection limits (MDLs). Five compounds, including carbon tetrachloride, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene (PCE), and trichloroethene (TCE), which are governed by the NYSDOH Decision Matrices, were detected in at least one of the sub-slab soil vapor and/or indoor air samples. All parameter concentration comparisons to the NYSDOH Decision Matrices indicate “No Further Action” with the exception of methylene chloride in IA-1 and IA-2 and TCE in SS-1 and IA-1. Methylene chloride and TCE concentration comparisons to the NYSDOH Decision Matrices at the previously mentioned locations indicate “Identify Source(s) and Resample or Mitigate” for methylene chloride and “Monitor” for TCE.

Several additional VOCs were identified above laboratory MDLs in the sub-slab soil vapor, indoor air, and outdoor air samples. The VOCs were generally either not detected in the indoor air samples or at concentrations remaining below the USEPA 2001 Base Database 90th percentile values with the exception of chloroform at IA-1 and IA-2. The sub-slab soil vapor, indoor air and outdoor air analytical results are summarized in Table 1. A copy of the laboratory report is included in Attachment 2.

CONCLUSIONS AND RECOMMENDATIONS

A majority of the current building layout consists of a wood floor above earthen ground representing a vapor pathway into the interior of the Site Building. It is LaBella’s understanding that a vapor barrier with a layer of compacted stone is intended for installation during renovation of the Site Building interior. Given the marginal concentrations of TCE, methylene chloride and chloroform identified within the indoor air samples, implementation of the new vapor barrier would likely mitigate the currently identified indoor air concentrations of these constituents.

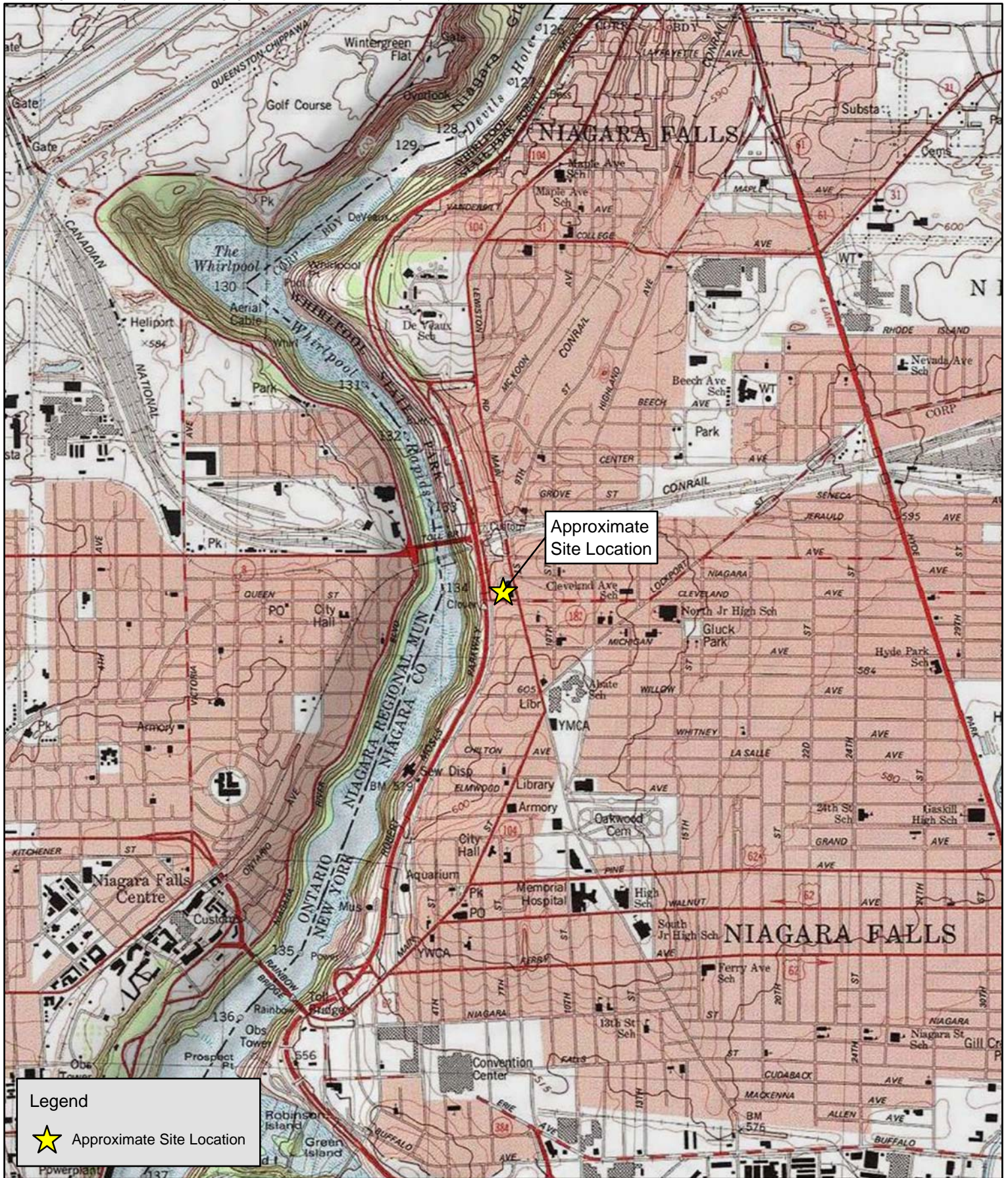
We appreciate the opportunity to serve your professional environmental engineering needs. If you have any questions, please do not hesitate to contact me at (716) 768-4906.

Sincerely,

Chris Kibler
Project Manager
Environmental Professional

Andrew Koons
Geologist
Environmental Professional

FIGURES



Approximate Site Location

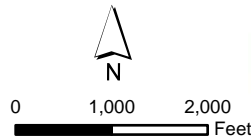
Legend

★ Approximate Site Location

PROJECT # / DRAWING # / DATE:
 [2221723]
 [**Figure 1**]
 [6/12/2023]





DRAWING NAME:
Site Location Map

PROJECT:
Vapor Intrusion Assessment
 822 Cleveland Avenue
 Niagara Falls, New York





Legend

-  Approximate Location of Indoor Air Sample
-  Approximate Location of Outdoor Air Sample
-  Approximate Location of Sub-Slab Soil Vapor Sample
-  Approximate Site Boundary

PROJECT # / DRAWING # /
DATE:

[2221723]
[**Figure 2**]
[6/12/2023]

DRAWING NAME:

**Site Investigation
Map**

PROJECT:

**Vapor Intrusion
Assessment**
822 Cleveland Avenue
Niagara Falls, New York



0 10 20
Feet



TABLE

Table 1
Summary of VOCs in Sub-slab Soil Vapor, Indoor Air and Outdoor Air
Vapor Intrusion Assessment
822 Cleveland Avenue
Niagara Falls, New York

SAMPLE ID:	SS-1	IA-1	SS-2	IA-2	OA-1	NYSDOH Sub-Slab Vapor Concentration Decision Matrix (minimum action level) ⁽¹⁾	NYSDOH Indoor Air Concentration (minimum action level) ⁽²⁾	NYSDOH Guidance Table C2 USEPA BASE Database - 90th Percentile ⁽²⁾
COLLECTION DATE:	5/25/2023	5/25/2023	5/25/2023	5/25/2023	4/26/2023			
SAMPLE MATRIX:	SOIL VAPOR	INDOOR AIR	SOIL VAPOR	INDOOR AIR	OUTDOOR AIR			
ANALYTE	Result	Result	Result	Result	Result			
VOLATILE ORGANIC COMPOUNDS								
1,2,4-Trimethylbenzene	13.0	<	1.02	<	<	NL	NL	9.5
1,3,5-Trimethylbenzene	8.36	<	<	<	<	NL	NL	3.7
1,3-Butadiene	0.595	<	<	<	<	NL	NL	NL
2,2,4-Trimethylpentane	1.13	<	<	<	<	NL	NL	NL
2-Butanone (Methyl Ethyl Ketone)	28.3	<	2.26	<	<	NL	NL	12
2-Hexanone	0.984	<	<	<	<	NL	NL	NL
4-Ethyltoluene	1.8	<	<	<	<	NL	NL	3.6
4-Methyl-2-pentanone	4.47	<	<	<	<	NL	NL	6
Acetone	156	6.96	8.29	6.01	6.53	NL	NL	98.9
Benzene	62.3	<	1.69	<	<	NL	NL	9.4
Bromodichloromethane	5.95	<	<	<	<	NL	NL	NL
Carbon disulfide	11.3	<	<	<	0.859	NL	NL	4.2
Carbon tetrachloride	<	0.554	<	0.510	0.610	6*	0.2*	<1.3
Chloroform	20.9	3.52	4.52	3.87	<	NL	NL	1.1
Chloromethane	0.814	0.907	<	0.876	1.02	NL	NL	3.7
cis-1,2-Dichloroethene	<	0.115	<	0.174	0.452	6**	0.2**	<1.9
Cyclohexane	36.5	<	4.54	<	<	NL	NL	NL
Dichlorodifluoromethane	2.34	2.52	2.38	2.44	2.43	NL	NL	16.5
Ethanol	16.1	<	<	<	<	NL	NL	210
Ethylbenzene	24.7	<	1.11	<	<	NL	NL	5.7
Heptane	81.1	<	10.6	<	<	NL	NL	NL
Isopropanol	2.83	<	<	<	<	NL	NL	250
Methylene chloride	7.36	16.7	5.07	18.4	2.29	100**	3**	10
n-Hexane	80.4	<	9.48	<	<	NL	NL	10.2
o-Xylene	46.5	<	1.84	<	<	NL	NL	7.9
p/m-Xylene	108	<	5.34	<	<	NL	NL	22.2
Styrene	5.79	<	<	<	<	NL	NL	1.9
Tetrachloroethene	18.3	0.753	1.70	0.814	0.590	100**	3**	15.9
Tetrahydrofuran	<	<	2.89	<	<	NL	NL	NL
Toluene	146	<	7.08	<	<	NL	NL	43
Trichloroethene	14.0	0.210	1.23	0.231	0.145	6**	0.2**	4.2
Trichlorofluoromethane	<	1.76	2.14	4.80	1.35	NL	NL	18.1

Notes:

Concentrations in micrograms per cubic meter (ug/m³)

Samples analyzed for VOCs by USEPA Method TO-15.

<< indicates concentration was not detected above the laboratory method detection limit.

(1) New York State Department of Health (NYSDOH), *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, October 2006 and subsequent updates. [Note: This Guidance uses a combination of indoor air and sub-slab soil vapor when comparing to the matrices. In addition, for compounds not listed in the matrices an overall site approach is employed which utilizes the USEPA BASE Database (see 2. below) as typical background for commercial buildings and also uses the outdoor air sample, refer to Guidance document for details.]

(2) USEPA Building Assessment and Survey Evaluation (BASE) Database (90th Percentile). As recommended in Section 3.2.4 of the NYSDOH Guidance (Refer to Footnote *1*) this database is referenced for the indoor air sampling results. This database is also referenced to provide initial benchmarks for comparison to the air sampling data and does not represent regulatory standards or compliance values.

*= Guideline Value obtained from Soil Vapor/Indoor Air Matrix A (minimum action level), NYSDOH, *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* May 2017.

**= Guidance Value obtained from Soil Vapor/Indoor Air Matrix B (minimum action level), NYSDOH, *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* May 2017.

***Guidance Value obtained from Soil Vapor/Indoor Air Matrix C (minimum action level), NYSDOH, *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* May 2017.

Red values are above the NYSDEC Guidance Table C2 USEPA BASE Database 90th Percentile Value for indoor air.

NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York, May 2017 Decision Matrices Notes:

NO FURTHER ACTION:

No additional actions are recommended to address human exposures

IDENTIFY SOURCE(S) AND RESAMPLE OR MITIGATE:

We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

MONITOR:

We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site, building, and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:

We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

ATTACHMENT 1

Field Sampling Logs and NYSDOH Questionnaire



AIR SAMPLING FIELD REPORT

AIR SAMPLING POINT

IA-1

Project: 822 Cleveland Avenue - VIA LaBella Project No.: 2221723
 Site Location: 822 Cleveland Avenue, Niagara Falls, New York LaBella Representative: A. Koons
 Client: Niagara University Weather: Sunny and 50°F

General Information

Sample Canister Location: Basement in front of stage

Sample Source: Indoor Air Sub-Slab Exterior Ambient Air Exterior Soil Gas
 Other

Shipping Date: 5/25/2023 Laboratory: Alpha Analytical

Canister Type: 1.0 L Summa Canister 6.0 L Summa Canister Other (specify): 2.7 L

Canister Serial No.: 3191 Flow Controller Serial No.: 01851

Time	Vacuum Reading (inHg)	Notes
<u>9:40</u>	<u>-27.04</u>	
<u>11:10</u>	<u>-23.03</u>	
<u>12:46</u>	<u>-18.72</u>	
<u>14:06</u>	<u>-15.26</u>	

Sampling Information

Sample Date: 5/25/23 Sampler: A. Koons

Sample Height / Depth: _____

	<u>Start</u>	<u>Stop</u>
Canister Pressure Gauge Reading:	<u>-30.23</u>	<u>-11.04</u>
Sample Time:	<u>8:31</u>	<u>15:37</u>

Comments:



AIR SAMPLING FIELD REPORT

AIR
SAMPLING
POINT

SS-1

Project: 822 Cleveland Avenue - VIA LaBella Project No.: 2221723
 Site Location: 822 Cleveland Avenue, Niagara Falls, New York LaBella Representative: A. Koons
 Client: Niagara University Weather: Sunny and 50°F

General Information

Sample Canister Location: Basement in front of stage

Sample Source: Indoor Air Sub-Slab Exterior Ambient Air Exterior Soil Gas
 Other

Shipping Date: 5/25/2023 Laboratory: Alpha Analytical

Canister Type: 1.0 L Summa Canister 6.0 L Summa Canister Other (specify): 2.7 L

Canister Serial No.: 448 Flow Controller Serial No.: 0981

Time	Vacuum Reading (inHg)	Notes
<u>9:41</u>	<u>-27.09</u>	
<u>11:11</u>	<u>-23.44</u>	
<u>12:47</u>	<u>-19.55</u>	
<u>14:07</u>	<u>-16.48</u>	

Sampling Information

Sample Date: 5/25/23 Sampler: A. Koons

Sample Height / Depth: _____

	<u>Start</u>	<u>Stop</u>
Canister Pressure Gauge Reading:	<u>-30.15</u>	<u>-12.66</u>
Sample Time:	<u>8:30</u>	<u>15:36</u>

Comments:



AIR SAMPLING FIELD REPORT

AIR SAMPLING POINT

IA-2

Project: 822 Cleveland Avenue - VIA LaBella Project No.: 2221723
 Site Location: 822 Cleveland Avenue, Niagara Falls, New York LaBella Representative: A. Koons
 Client: Niagara University Weather: Sunny and 50°F

General Information

Sample Canister Location: Basement in kitchen

Sample Source: Indoor Air Sub-Slab Exterior Ambient Air Exterior Soil Gas
 Other

Shipping Date: 5/25/2023 Laboratory: Alpha Analytical

Canister Type: 1.0 L Summa Canister 6.0 L Summa Canister Other (specify): 2.7 L

Canister Serial No.: 2044 Flow Controller Serial No.: 01601

Time	Vacuum Reading (inHg)	Notes
<u>9:42</u>	<u>-26.80</u>	
<u>11:12</u>	<u>-22.19</u>	
<u>12:48</u>	<u>-17.23</u>	
<u>14:08</u>	<u>-13.31</u>	

Sampling Information

Sample Date: 5/25/23 Sampler: A. Koons

Sample Height / Depth: _____

	<u>Start</u>	<u>Stop</u>
Canister Pressure Gauge Reading:	<u>-30.20</u>	<u>-7.63</u>
Sample Time:	<u>8:35</u>	<u>15:38</u>

Comments:



AIR SAMPLING FIELD REPORT

AIR SAMPLING POINT

SS-2

Project: 822 Cleveland Avenue - VIA
Site Location: 822 Cleveland Avenue, Niagara Falls, New York
Client: Niagara University

LaBella Project No.: 2221723
LaBella Representative: A. Koons
Weather: Sunny and 50°F

General Information

Sample Canister Location: Basement in kitchen

Sample Source: Indoor Air x Sub-Slab Exterior Ambient Air Exterior Soil Gas
 Other

Shipping Date: 5/25/2023 Laboratory: Alpha Analytical

Canister Type: 1.0 L Summa Canister 6.0 L Summa Canister Other (specify): 2.7 L

Canister Serial No.: 448 Flow Controller Serial No.: 0471

Time	Vacuum Reading (inHg)	Notes
<u>9:43</u>	<u>-26.75</u>	
<u>11:13</u>	<u>-22.23</u>	
<u>12:49</u>	<u>-17.35</u>	
<u>14:09</u>	<u>-13.4</u>	
<u> </u>	<u> </u>	
<u> </u>	<u> </u>	
<u> </u>	<u> </u>	
<u> </u>	<u> </u>	
<u> </u>	<u> </u>	

Sampling Information

Sample Date: 5/25/23 Sampler: A. Koons

Sample Height / Depth:

 Start Stop

Canister Pressure Gauge Reading: -30.19 -8.42

Sample Time: 8:34 15:39

Comments:



AIR SAMPLING FIELD REPORT

AIR SAMPLING POINT

OA-1

Project: 822 Cleveland Avenue - VIA
 Site Location: 822 Cleveland Avenue, Niagara Falls, New York
 Client: Niagara University

LaBella Project No.: 2221723
 LaBella Representative: A. Koons
 Weather: Sunny and 50°F

General Information

Sample Canister Location: Southwest exterior

Sample Source: Indoor Air Sub-Slab Exterior Ambient Air Exterior Soil Gas
 Other

Shipping Date: 5/25/2023 Laboratory: Alpha Analytical

Canister Type: 1.0 L Summa Canister 6.0 L Summa Canister Other (specify): 2.7 L

Canister Serial No.: 3901 Flow Controller Serial No.: 02086

Time	Vacuum Reading (inHg)	Notes
<u>9:38</u>	<u>-26.96</u>	
<u>11:07</u>	<u>-22.74</u>	
<u>12:45</u>	<u>-18.32</u>	
<u>14:04</u>	<u>-14.96</u>	

Sampling Information

Sample Date: 5/25/23 Sampler: A. Koons

Sample Height / Depth: _____

	<u>Start</u>	<u>Stop</u>
Canister Pressure Gauge Reading:	<u>-29.88</u>	<u>-10.95</u>
Sample Time:	<u>8:37</u>	<u>15:35</u>

Comments:

**NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH**

This form must be completed for each residence involved in indoor air testing.

Preparer's Name Andrew Koone Date/Time Prepared 5/28/23
Preparer's Affiliation Consultant Phone No. 716.417.9156
Purpose of Investigation Vapor Intrusion Assessment

1. OCCUPANT:

Interviewed: Y N

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

Number of Occupants/persons at this location _____ Age of Occupants _____

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y N

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential
Industrial

School
 Church

Commercial/Multi-use
Other: _____

If the property is residential, type? (Circle appropriate response)

- | | | |
|--------------|-----------------|-------------------|
| Ranch | 2-Family | 3-Family |
| Raised Ranch | Split Level | Colonial |
| Cape Cod | Contemporary | Mobile Home |
| Duplex | Apartment House | Townhouses/Condos |
| Modular | Log Home | Other: _____ |

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) Church

Does it include residences (i.e., multi-use)? Y N _____ If yes, how many? _____

Other characteristics:

Number of floors 2 Building age _____

Is the building insulated? Y / N How air tight? Tight Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

Ø

Airflow near source

Ø

Outdoor air infiltration

Ø

Infiltration into air ducts

Ø

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

- a. Above grade construction: wood frame concrete stone brick
- b. Basement type: full crawlspace slab other _____
- c. Basement floor: concrete dirt stone other _____
- d. Basement floor: uncovered covered covered with _____
- e. Concrete floor: unsealed sealed sealed with _____
- f. Foundation walls: poured block stone other _____
- g. Foundation walls: unsealed sealed sealed with _____
- h. The basement is: wet damp dry moldy
- i. The basement is: finished unfinished partially finished
- j. Sump present? Y/N
- k. Water in sump? Y/N/not applicable

Basement/Lowest level depth below grade: _____ (feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Cracks in floors, earthen floors under wooden floors,
Brick floors

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

- Hot air circulation
- Space Heaters
- Electric baseboard
- Heat pump
- Stream radiation
- Wood stove
- Hot water baseboard
- Radiant floor
- Outdoor wood boiler
- Other _____

The primary type of fuel used is:

- Natural Gas
- Electric
- Wood
- Fuel Oil
- Propane
- Coal
- Kerosene
- Solar

Domestic hot water tank fueled by: Natural gas

Boiler/furnace located in: Basement Outdoors Main Floor Other _____

Air conditioning: Central Air Window units Open Windows None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

Ø

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level **General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**

Basement	<u>Stage, Kitchen, dining rooms, bathrooms, Storage</u>
1 st Floor	_____
2 nd Floor	_____
3 rd Floor	_____
4 th Floor	_____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

- a. Is there an attached garage? Y N
- b. Does the garage have a separate heating unit? Y / N / NA
- c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / NA
Please specify _____
- d. Has the building ever had a fire? Y / N When? _____
- e. Is a kerosene or unvented gas space heater present? Y / N Where? _____
- f. Is there a workshop or hobby/craft area? Y / N Where & Type? _____
- g. Is there smoking in the building? Y N How frequently? _____
- h. Have cleaning products been used recently? Y N When & Type? _____
- i. Have cosmetic products been used recently? Y N When & Type? _____

- j. Has painting/staining been done in the last 6 months? Y/N Where & When? _____
- k. Is there new carpet, drapes or other textiles? Y/N Where & When? _____
- l. Have air fresheners been used recently? Y/N When & Type? _____
- m. Is there a kitchen exhaust fan? Y/N If yes, where vented? outside
- n. Is there a bathroom exhaust fan? Y/N If yes, where vented? _____
- o. Is there a clothes dryer? Y/N If yes, is it vented outside? Y / N
- p. Has there been a pesticide application? Y/N When & Type? _____

Are there odors in the building? Y/N
 If yes, please describe: _____

Do any of the building occupants use solvents at work? Y/N
 (e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist)

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

- Yes, use dry-cleaning regularly (weekly) No
- Yes, use dry-cleaning infrequently (monthly or less) Unknown
- Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y/N Date of Installation: _____
 Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply: Public Water Drilled Well Driven Well Dug Well Other: _____

Sewage Disposal: Public Sewer Septic Tank Leach Field Dry Well Other: _____

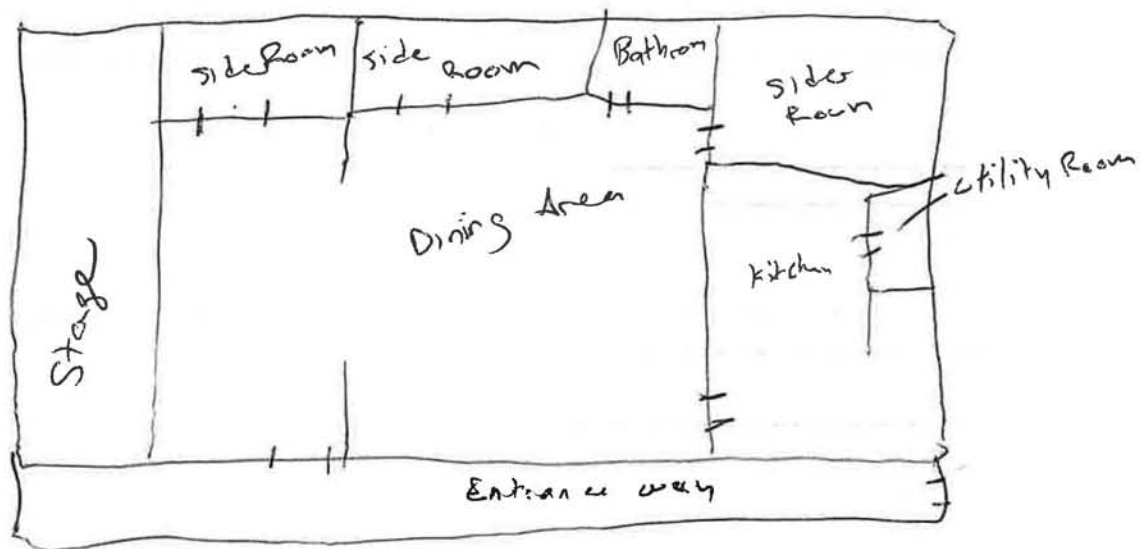
10. RELOCATION INFORMATION (for oil spill residential emergency)

- a. Provide reasons why relocation is recommended: /
- b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel
- c. Responsibility for costs associated with reimbursement explained? Y / N
- d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:



First Floor:

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

See figures

ATTACHMENT 2

Laboratory Analytical Report



ANALYTICAL REPORT

Lab Number:	L2329512
Client:	LaBella Associates, P.C. 300 Pearl Street Suite 252 Buffalo, NY 14202
ATTN:	Christopher Kibler
Phone:	(716) 551-6281
Project Name:	822 CLEVELAND AVE - VIA
Project Number:	2221723
Report Date:	06/09/23

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA030), NH NELAP (2062), CT (PH-0825), DoD (L2474), FL (E87814), IL (200081), IN (C-MA-04), KY (KY98046), LA (85084), ME (MA00030), MD (350), MI (99110), NJ (MA015), NY (11627), NC (685), OH (CL106), OR (MA-0262), PA (68-02089), RI (LAO00299), TX (T104704419), VT (VT-0015), VA (460194), WA (C954), US Army Corps of Engineers, USDA (Permit #525-23-107-88708), USFWS (Permit #206964).

320 Forbes Boulevard, Mansfield, MA 02048-1806
508-822-9300 (Fax) 508-822-3288 800-624-9220 - www.alphalab.com



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2329512-01	SS-1	SOIL_VAPOR	NIAGARA FALLS NY	05/25/23 15:36	05/25/23
L2329512-02	IA-1	AIR	NIAGARA FALLS NY	05/25/23 15:37	05/25/23
L2329512-03	SS-2	SOIL_VAPOR	NIAGARA FALLS NY	05/25/23 15:39	05/25/23
L2329512-04	IA-2	AIR	NIAGARA FALLS NY	05/25/23 15:38	05/25/23
L2329512-05	OA-1	AIR	NIAGARA FALLS NY	05/25/23 15:35	05/25/23

Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

Case Narrative (continued)

Volatile Organics in Air

Canisters were released from the laboratory on May 23, 2023. The canister certification results are provided as an addendum.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:

 Jennifer Jerome

Title: Technical Director/Representative

Date: 06/09/23

AIR

Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

SAMPLE RESULTS

Lab ID: L2329512-01
 Client ID: SS-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:36
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Soil_Vapor
 Analytical Method: 48,TO-15
 Analytical Date: 06/08/23 22:38
 Analyst: APR

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Dichlorodifluoromethane	0.473	0.200	--	2.34	0.989	--		1
Chloromethane	0.394	0.200	--	0.814	0.413	--		1
Freon-114	ND	0.200	--	ND	1.40	--		1
Vinyl chloride	ND	0.200	--	ND	0.511	--		1
1,3-Butadiene	0.269	0.200	--	0.595	0.442	--		1
Bromomethane	ND	0.200	--	ND	0.777	--		1
Chloroethane	ND	0.200	--	ND	0.528	--		1
Ethanol	8.54	5.00	--	16.1	9.42	--		1
Vinyl bromide	ND	0.200	--	ND	0.874	--		1
Acetone	65.8	1.00	--	156	2.38	--		1
Trichlorofluoromethane	0.242	0.200	--	1.36	1.12	--		1
Isopropanol	1.15	0.500	--	2.83	1.23	--		1
1,1-Dichloroethene	ND	0.200	--	ND	0.793	--		1
Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--		1
Methylene chloride	2.12	0.500	--	7.36	1.74	--		1
3-Chloropropene	ND	0.200	--	ND	0.626	--		1
Carbon disulfide	3.62	0.200	--	11.3	0.623	--		1
Freon-113	ND	0.200	--	ND	1.53	--		1
trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
1,1-Dichloroethane	ND	0.200	--	ND	0.809	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
2-Butanone	9.58	0.500	--	28.3	1.47	--		1
cis-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

SAMPLE RESULTS

Lab ID: L2329512-01
 Client ID: SS-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:36
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Ethyl Acetate	ND	0.500	--	ND	1.80	--		1
Chloroform	4.29	0.200	--	20.9	0.977	--		1
Tetrahydrofuran	ND	0.500	--	ND	1.47	--		1
1,2-Dichloroethane	ND	0.200	--	ND	0.809	--		1
n-Hexane	22.8	0.200	--	80.4	0.705	--		1
1,1,1-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Benzene	19.5	0.200	--	62.3	0.639	--		1
Carbon tetrachloride	ND	0.200	--	ND	1.26	--		1
Cyclohexane	10.6	0.200	--	36.5	0.688	--		1
1,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
Bromodichloromethane	0.888	0.200	--	5.95	1.34	--		1
1,4-Dioxane	ND	0.200	--	ND	0.721	--		1
Trichloroethene	2.60	0.200	--	14.0	1.07	--		1
2,2,4-Trimethylpentane	0.242	0.200	--	1.13	0.934	--		1
Heptane	19.8	0.200	--	81.1	0.820	--		1
cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
4-Methyl-2-pentanone	1.09	0.500	--	4.47	2.05	--		1
trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Toluene	38.8	0.200	--	146	0.754	--		1
2-Hexanone	0.240	0.200	--	0.984	0.820	--		1
Dibromochloromethane	ND	0.200	--	ND	1.70	--		1
1,2-Dibromoethane	ND	0.200	--	ND	1.54	--		1
Tetrachloroethene	2.70	0.200	--	18.3	1.36	--		1
Chlorobenzene	ND	0.200	--	ND	0.921	--		1
Ethylbenzene	5.68	0.200	--	24.7	0.869	--		1



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-01

Date Collected: 05/25/23 15:36

Client ID: SS-1

Date Received: 05/25/23

Sample Location: NIAGARA FALLS NY

Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
p/m-Xylene	24.9	0.400	--	108	1.74	--		1
Bromoform	ND	0.200	--	ND	2.07	--		1
Styrene	1.36	0.200	--	5.79	0.852	--		1
1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1
o-Xylene	10.7	0.200	--	46.5	0.869	--		1
4-Ethyltoluene	0.367	0.200	--	1.80	0.983	--		1
1,3,5-Trimethylbenzene	1.70	0.200	--	8.36	0.983	--		1
1,2,4-Trimethylbenzene	2.64	0.200	--	13.0	0.983	--		1
Benzyl chloride	ND	0.200	--	ND	1.04	--		1
1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Hexachlorobutadiene	ND	0.200	--	ND	2.13	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-Difluorobenzene	99		60-140
Bromochloromethane	99		60-140
chlorobenzene-d5	101		60-140



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

SAMPLE RESULTS

Lab ID: L2329512-02
 Client ID: IA-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:37
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15
 Analytical Date: 06/08/23 20:42
 Analyst: APR

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Dichlorodifluoromethane	0.509	0.200	--	2.52	0.989	--		1
Chloromethane	0.439	0.200	--	0.907	0.413	--		1
Freon-114	ND	0.200	--	ND	1.40	--		1
1,3-Butadiene	ND	0.200	--	ND	0.442	--		1
Bromomethane	ND	0.200	--	ND	0.777	--		1
Chloroethane	ND	0.200	--	ND	0.528	--		1
Ethanol	ND	5.00	--	ND	9.42	--		1
Vinyl bromide	ND	0.200	--	ND	0.874	--		1
Acetone	2.93	1.00	--	6.96	2.38	--		1
Trichlorofluoromethane	0.314	0.200	--	1.76	1.12	--		1
Isopropanol	ND	0.500	--	ND	1.23	--		1
Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--		1
Methylene chloride	4.81	0.500	--	16.7	1.74	--		1
3-Chloropropene	ND	0.200	--	ND	0.626	--		1
Carbon disulfide	ND	0.200	--	ND	0.623	--		1
Freon-113	ND	0.200	--	ND	1.53	--		1
trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
1,1-Dichloroethane	ND	0.200	--	ND	0.809	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
2-Butanone	ND	0.500	--	ND	1.47	--		1
Ethyl Acetate	ND	0.500	--	ND	1.80	--		1
Chloroform	0.720	0.200	--	3.52	0.977	--		1
Tetrahydrofuran	ND	0.500	--	ND	1.47	--		1



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

SAMPLE RESULTS

Lab ID: L2329512-02
 Client ID: IA-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:37
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
1,2-Dichloroethane	ND	0.200	--	ND	0.809	--		1
n-Hexane	ND	0.200	--	ND	0.705	--		1
Benzene	ND	0.200	--	ND	0.639	--		1
Cyclohexane	ND	0.200	--	ND	0.688	--		1
1,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
Bromodichloromethane	ND	0.200	--	ND	1.34	--		1
1,4-Dioxane	ND	0.200	--	ND	0.721	--		1
2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--		1
Heptane	ND	0.200	--	ND	0.820	--		1
cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Toluene	ND	0.200	--	ND	0.754	--		1
2-Hexanone	ND	0.200	--	ND	0.820	--		1
Dibromochloromethane	ND	0.200	--	ND	1.70	--		1
1,2-Dibromoethane	ND	0.200	--	ND	1.54	--		1
Chlorobenzene	ND	0.200	--	ND	0.921	--		1
Ethylbenzene	ND	0.200	--	ND	0.869	--		1
p/m-Xylene	ND	0.400	--	ND	1.74	--		1
Bromoform	ND	0.200	--	ND	2.07	--		1
Styrene	ND	0.200	--	ND	0.852	--		1
1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1
o-Xylene	ND	0.200	--	ND	0.869	--		1
4-Ethyltoluene	ND	0.200	--	ND	0.983	--		1
1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-02
 Client ID: IA-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:37
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
Benzyl chloride	ND	0.200	--	ND	1.04	--		1
1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Hexachlorobutadiene	ND	0.200	--	ND	2.13	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-Difluorobenzene	94		60-140
Bromochloromethane	96		60-140
chlorobenzene-d5	94		60-140



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-02
 Client ID: IA-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:37
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15-SIM
 Analytical Date: 06/08/23 20:42
 Analyst: APR

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Vinyl chloride	ND	0.020	--	ND	0.051	--		1
1,1-Dichloroethene	ND	0.020	--	ND	0.079	--		1
cis-1,2-Dichloroethene	0.029	0.020	--	0.115	0.079	--		1
1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--		1
Carbon tetrachloride	0.088	0.020	--	0.554	0.126	--		1
Trichloroethene	0.039	0.020	--	0.210	0.107	--		1
Tetrachloroethene	0.111	0.020	--	0.753	0.136	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	92		60-140
bromochloromethane	93		60-140
chlorobenzene-d5	93		60-140



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

SAMPLE RESULTS

Lab ID: L2329512-03
 Client ID: SS-2
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:39
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Soil_Vapor
 Analytical Method: 48,TO-15
 Analytical Date: 06/08/23 23:16
 Analyst: APR

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Dichlorodifluoromethane	0.481	0.200	--	2.38	0.989	--		1
Chloromethane	ND	0.200	--	ND	0.413	--		1
Freon-114	ND	0.200	--	ND	1.40	--		1
Vinyl chloride	ND	0.200	--	ND	0.511	--		1
1,3-Butadiene	ND	0.200	--	ND	0.442	--		1
Bromomethane	ND	0.200	--	ND	0.777	--		1
Chloroethane	ND	0.200	--	ND	0.528	--		1
Ethanol	ND	5.00	--	ND	9.42	--		1
Vinyl bromide	ND	0.200	--	ND	0.874	--		1
Acetone	3.49	1.00	--	8.29	2.38	--		1
Trichlorofluoromethane	0.381	0.200	--	2.14	1.12	--		1
Isopropanol	ND	0.500	--	ND	1.23	--		1
1,1-Dichloroethene	ND	0.200	--	ND	0.793	--		1
Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--		1
Methylene chloride	1.46	0.500	--	5.07	1.74	--		1
3-Chloropropene	ND	0.200	--	ND	0.626	--		1
Carbon disulfide	ND	0.200	--	ND	0.623	--		1
Freon-113	ND	0.200	--	ND	1.53	--		1
trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
1,1-Dichloroethane	ND	0.200	--	ND	0.809	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
2-Butanone	0.766	0.500	--	2.26	1.47	--		1
cis-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-03
 Client ID: SS-2
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:39
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Ethyl Acetate	ND	0.500	--	ND	1.80	--		1
Chloroform	0.926	0.200	--	4.52	0.977	--		1
Tetrahydrofuran	0.979	0.500	--	2.89	1.47	--		1
1,2-Dichloroethane	ND	0.200	--	ND	0.809	--		1
n-Hexane	2.69	0.200	--	9.48	0.705	--		1
1,1,1-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Benzene	0.528	0.200	--	1.69	0.639	--		1
Carbon tetrachloride	ND	0.200	--	ND	1.26	--		1
Cyclohexane	1.32	0.200	--	4.54	0.688	--		1
1,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
Bromodichloromethane	ND	0.200	--	ND	1.34	--		1
1,4-Dioxane	ND	0.200	--	ND	0.721	--		1
Trichloroethene	0.229	0.200	--	1.23	1.07	--		1
2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--		1
Heptane	2.59	0.200	--	10.6	0.820	--		1
cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Toluene	1.88	0.200	--	7.08	0.754	--		1
2-Hexanone	ND	0.200	--	ND	0.820	--		1
Dibromochloromethane	ND	0.200	--	ND	1.70	--		1
1,2-Dibromoethane	ND	0.200	--	ND	1.54	--		1
Tetrachloroethene	0.251	0.200	--	1.70	1.36	--		1
Chlorobenzene	ND	0.200	--	ND	0.921	--		1
Ethylbenzene	0.256	0.200	--	1.11	0.869	--		1



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-03
 Client ID: SS-2
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:39
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
p/m-Xylene	1.23	0.400	--	5.34	1.74	--		1
Bromoform	ND	0.200	--	ND	2.07	--		1
Styrene	ND	0.200	--	ND	0.852	--		1
1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1
o-Xylene	0.423	0.200	--	1.84	0.869	--		1
4-Ethyltoluene	ND	0.200	--	ND	0.983	--		1
1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
1,2,4-Trimethylbenzene	0.207	0.200	--	1.02	0.983	--		1
Benzyl chloride	ND	0.200	--	ND	1.04	--		1
1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Hexachlorobutadiene	ND	0.200	--	ND	2.13	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-Difluorobenzene	98		60-140
Bromochloromethane	99		60-140
chlorobenzene-d5	100		60-140



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-04
 Client ID: IA-2
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:38
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15
 Analytical Date: 06/08/23 21:20
 Analyst: APR

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Dichlorodifluoromethane	0.493	0.200	--	2.44	0.989	--		1
Chloromethane	0.424	0.200	--	0.876	0.413	--		1
Freon-114	ND	0.200	--	ND	1.40	--		1
1,3-Butadiene	ND	0.200	--	ND	0.442	--		1
Bromomethane	ND	0.200	--	ND	0.777	--		1
Chloroethane	ND	0.200	--	ND	0.528	--		1
Ethanol	ND	5.00	--	ND	9.42	--		1
Vinyl bromide	ND	0.200	--	ND	0.874	--		1
Acetone	2.53	1.00	--	6.01	2.38	--		1
Trichlorofluoromethane	0.854	0.200	--	4.80	1.12	--		1
Isopropanol	ND	0.500	--	ND	1.23	--		1
Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--		1
Methylene chloride	5.31	0.500	--	18.4	1.74	--		1
3-Chloropropene	ND	0.200	--	ND	0.626	--		1
Carbon disulfide	ND	0.200	--	ND	0.623	--		1
Freon-113	ND	0.200	--	ND	1.53	--		1
trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
1,1-Dichloroethane	ND	0.200	--	ND	0.809	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
2-Butanone	ND	0.500	--	ND	1.47	--		1
Ethyl Acetate	ND	0.500	--	ND	1.80	--		1
Chloroform	0.792	0.200	--	3.87	0.977	--		1
Tetrahydrofuran	ND	0.500	--	ND	1.47	--		1



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

SAMPLE RESULTS

Lab ID: L2329512-04
 Client ID: IA-2
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:38
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
1,2-Dichloroethane	ND	0.200	--	ND	0.809	--		1
n-Hexane	ND	0.200	--	ND	0.705	--		1
Benzene	ND	0.200	--	ND	0.639	--		1
Cyclohexane	ND	0.200	--	ND	0.688	--		1
1,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
Bromodichloromethane	ND	0.200	--	ND	1.34	--		1
1,4-Dioxane	ND	0.200	--	ND	0.721	--		1
2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--		1
Heptane	ND	0.200	--	ND	0.820	--		1
cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Toluene	ND	0.200	--	ND	0.754	--		1
2-Hexanone	ND	0.200	--	ND	0.820	--		1
Dibromochloromethane	ND	0.200	--	ND	1.70	--		1
1,2-Dibromoethane	ND	0.200	--	ND	1.54	--		1
Chlorobenzene	ND	0.200	--	ND	0.921	--		1
Ethylbenzene	ND	0.200	--	ND	0.869	--		1
p/m-Xylene	ND	0.400	--	ND	1.74	--		1
Bromoform	ND	0.200	--	ND	2.07	--		1
Styrene	ND	0.200	--	ND	0.852	--		1
1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1
o-Xylene	ND	0.200	--	ND	0.869	--		1
4-Ethyltoluene	ND	0.200	--	ND	0.983	--		1
1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-04
 Client ID: IA-2
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:38
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
Benzyl chloride	ND	0.200	--	ND	1.04	--		1
1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Hexachlorobutadiene	ND	0.200	--	ND	2.13	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-Difluorobenzene	94		60-140
Bromochloromethane	97		60-140
chlorobenzene-d5	96		60-140



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-04
 Client ID: IA-2
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:38
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15-SIM
 Analytical Date: 06/08/23 21:20
 Analyst: APR

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Vinyl chloride	ND	0.020	--	ND	0.051	--		1
1,1-Dichloroethene	ND	0.020	--	ND	0.079	--		1
cis-1,2-Dichloroethene	0.044	0.020	--	0.174	0.079	--		1
1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--		1
Carbon tetrachloride	0.081	0.020	--	0.510	0.126	--		1
Trichloroethene	0.043	0.020	--	0.231	0.107	--		1
Tetrachloroethene	0.120	0.020	--	0.814	0.136	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	93		60-140
bromochloromethane	94		60-140
chlorobenzene-d5	95		60-140



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-05
 Client ID: OA-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:35
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15
 Analytical Date: 06/08/23 17:29
 Analyst: APR

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Dichlorodifluoromethane	0.492	0.200	--	2.43	0.989	--		1
Chloromethane	0.494	0.200	--	1.02	0.413	--		1
Freon-114	ND	0.200	--	ND	1.40	--		1
1,3-Butadiene	ND	0.200	--	ND	0.442	--		1
Bromomethane	ND	0.200	--	ND	0.777	--		1
Chloroethane	ND	0.200	--	ND	0.528	--		1
Ethanol	ND	5.00	--	ND	9.42	--		1
Vinyl bromide	ND	0.200	--	ND	0.874	--		1
Acetone	2.75	1.00	--	6.53	2.38	--		1
Trichlorofluoromethane	0.240	0.200	--	1.35	1.12	--		1
Isopropanol	ND	0.500	--	ND	1.23	--		1
Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--		1
Methylene chloride	0.659	0.500	--	2.29	1.74	--		1
3-Chloropropene	ND	0.200	--	ND	0.626	--		1
Carbon disulfide	0.276	0.200	--	0.859	0.623	--		1
Freon-113	ND	0.200	--	ND	1.53	--		1
trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
1,1-Dichloroethane	ND	0.200	--	ND	0.809	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
2-Butanone	ND	0.500	--	ND	1.47	--		1
Ethyl Acetate	ND	0.500	--	ND	1.80	--		1
Chloroform	ND	0.200	--	ND	0.977	--		1
Tetrahydrofuran	ND	0.500	--	ND	1.47	--		1



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

SAMPLE RESULTS

Lab ID: L2329512-05
 Client ID: OA-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:35
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
1,2-Dichloroethane	ND	0.200	--	ND	0.809	--		1
n-Hexane	ND	0.200	--	ND	0.705	--		1
Benzene	ND	0.200	--	ND	0.639	--		1
Cyclohexane	ND	0.200	--	ND	0.688	--		1
1,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
Bromodichloromethane	ND	0.200	--	ND	1.34	--		1
1,4-Dioxane	ND	0.200	--	ND	0.721	--		1
2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--		1
Heptane	ND	0.200	--	ND	0.820	--		1
cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Toluene	ND	0.200	--	ND	0.754	--		1
2-Hexanone	ND	0.200	--	ND	0.820	--		1
Dibromochloromethane	ND	0.200	--	ND	1.70	--		1
1,2-Dibromoethane	ND	0.200	--	ND	1.54	--		1
Chlorobenzene	ND	0.200	--	ND	0.921	--		1
Ethylbenzene	ND	0.200	--	ND	0.869	--		1
p/m-Xylene	ND	0.400	--	ND	1.74	--		1
Bromoform	ND	0.200	--	ND	2.07	--		1
Styrene	ND	0.200	--	ND	0.852	--		1
1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1
o-Xylene	ND	0.200	--	ND	0.869	--		1
4-Ethyltoluene	ND	0.200	--	ND	0.983	--		1
1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-05
 Client ID: OA-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:35
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
Benzyl chloride	ND	0.200	--	ND	1.04	--		1
1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Hexachlorobutadiene	ND	0.200	--	ND	2.13	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-Difluorobenzene	94		60-140
Bromochloromethane	96		60-140
chlorobenzene-d5	95		60-140



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**SAMPLE RESULTS**

Lab ID: L2329512-05
 Client ID: OA-1
 Sample Location: NIAGARA FALLS NY

Date Collected: 05/25/23 15:35
 Date Received: 05/25/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15-SIM
 Analytical Date: 06/08/23 17:29
 Analyst: APR

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Vinyl chloride	ND	0.020	--	ND	0.051	--		1
1,1-Dichloroethene	ND	0.020	--	ND	0.079	--		1
cis-1,2-Dichloroethene	0.114	0.020	--	0.452	0.079	--		1
1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--		1
Carbon tetrachloride	0.097	0.020	--	0.610	0.126	--		1
Trichloroethene	0.027	0.020	--	0.145	0.107	--		1
Tetrachloroethene	0.087	0.020	--	0.590	0.136	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	91		60-140
bromochloromethane	93		60-140
chlorobenzene-d5	93		60-140



Project Name: 822 CLEVELAND AVE - VIA

Lab Number: L2329512

Project Number: 2221723

Report Date: 06/09/23

Method Blank Analysis Batch Quality Control

Analytical Method: 48,TO-15

Analytical Date: 06/08/23 15:26

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab for sample(s): 01-05 Batch: WG1788971-4								
Dichlorodifluoromethane	ND	0.200	--	ND	0.989	--		1
Chloromethane	ND	0.200	--	ND	0.413	--		1
Freon-114	ND	0.200	--	ND	1.40	--		1
Vinyl chloride	ND	0.200	--	ND	0.511	--		1
1,3-Butadiene	ND	0.200	--	ND	0.442	--		1
Bromomethane	ND	0.200	--	ND	0.777	--		1
Chloroethane	ND	0.200	--	ND	0.528	--		1
Ethanol	ND	5.00	--	ND	9.42	--		1
Vinyl bromide	ND	0.200	--	ND	0.874	--		1
Acetone	ND	1.00	--	ND	2.38	--		1
Trichlorofluoromethane	ND	0.200	--	ND	1.12	--		1
Isopropanol	ND	0.500	--	ND	1.23	--		1
1,1-Dichloroethene	ND	0.200	--	ND	0.793	--		1
Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--		1
Methylene chloride	ND	0.500	--	ND	1.74	--		1
3-Chloropropene	ND	0.200	--	ND	0.626	--		1
Carbon disulfide	ND	0.200	--	ND	0.623	--		1
Freon-113	ND	0.200	--	ND	1.53	--		1
trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
1,1-Dichloroethane	ND	0.200	--	ND	0.809	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
2-Butanone	ND	0.500	--	ND	1.47	--		1
cis-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
Ethyl Acetate	ND	0.500	--	ND	1.80	--		1
Chloroform	ND	0.200	--	ND	0.977	--		1



Project Name: 822 CLEVELAND AVE - VIA

Lab Number: L2329512

Project Number: 2221723

Report Date: 06/09/23

Method Blank Analysis Batch Quality Control

Analytical Method: 48,TO-15

Analytical Date: 06/08/23 15:26

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab for sample(s): 01-05 Batch: WG1788971-4								
Tetrahydrofuran	ND	0.500	--	ND	1.47	--		1
1,2-Dichloroethane	ND	0.200	--	ND	0.809	--		1
n-Hexane	ND	0.200	--	ND	0.705	--		1
1,1,1-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Benzene	ND	0.200	--	ND	0.639	--		1
Carbon tetrachloride	ND	0.200	--	ND	1.26	--		1
Cyclohexane	ND	0.200	--	ND	0.688	--		1
1,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
Bromodichloromethane	ND	0.200	--	ND	1.34	--		1
1,4-Dioxane	ND	0.200	--	ND	0.721	--		1
Trichloroethene	ND	0.200	--	ND	1.07	--		1
2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--		1
Heptane	ND	0.200	--	ND	0.820	--		1
cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Toluene	ND	0.200	--	ND	0.754	--		1
2-Hexanone	ND	0.200	--	ND	0.820	--		1
Dibromochloromethane	ND	0.200	--	ND	1.70	--		1
1,2-Dibromoethane	ND	0.200	--	ND	1.54	--		1
Tetrachloroethene	ND	0.200	--	ND	1.36	--		1
Chlorobenzene	ND	0.200	--	ND	0.921	--		1
Ethylbenzene	ND	0.200	--	ND	0.869	--		1
p/m-Xylene	ND	0.400	--	ND	1.74	--		1



Project Name: 822 CLEVELAND AVE - VIA

Lab Number: L2329512

Project Number: 2221723

Report Date: 06/09/23

Method Blank Analysis Batch Quality Control

Analytical Method: 48,TO-15

Analytical Date: 06/08/23 15:26

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab for sample(s): 01-05 Batch: WG1788971-4								
Bromoform	ND	0.200	--	ND	2.07	--		1
Styrene	ND	0.200	--	ND	0.852	--		1
1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1
o-Xylene	ND	0.200	--	ND	0.869	--		1
4-Ethyltoluene	ND	0.200	--	ND	0.983	--		1
1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
Benzyl chloride	ND	0.200	--	ND	1.04	--		1
1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Hexachlorobutadiene	ND	0.200	--	ND	2.13	--		1

Project Name: 822 CLEVELAND AVE - VIA

Lab Number: L2329512

Project Number: 2221723

Report Date: 06/09/23

Method Blank Analysis Batch Quality Control

Analytical Method: 48,TO-15-SIM

Analytical Date: 06/08/23 16:03

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab for sample(s): 02,04-05 Batch: WG1788974-4								
Vinyl chloride	ND	0.020	--	ND	0.051	--		1
1,1-Dichloroethene	ND	0.020	--	ND	0.079	--		1
cis-1,2-Dichloroethene	ND	0.020	--	ND	0.079	--		1
1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--		1
Carbon tetrachloride	ND	0.020	--	ND	0.126	--		1
Trichloroethene	ND	0.020	--	ND	0.107	--		1
Tetrachloroethene	ND	0.020	--	ND	0.136	--		1

Lab Control Sample Analysis

Batch Quality Control

Project Name: 822 CLEVELAND AVE - VIA

Lab Number: L2329512

Project Number: 2221723

Report Date: 06/09/23

Parameter	LCS	Qual	LCS	Qual	%Recovery	RPD	Qual	RPD
	%Recovery		%Recovery		Limits			Limits
Volatile Organics in Air - Mansfield Lab Associated sample(s): 01-05 Batch: WG1788971-3								
Dichlorodifluoromethane	96		-		70-130			-
Chloromethane	88		-		70-130			-
Freon-114	92		-		70-130			-
Vinyl chloride	91		-		70-130			-
1,3-Butadiene	88		-		70-130			-
Bromomethane	87		-		70-130			-
Chloroethane	89		-		70-130			-
Ethanol	85		-		40-160			-
Vinyl bromide	81		-		70-130			-
Acetone	104		-		40-160			-
Trichlorofluoromethane	98		-		70-130			-
Isopropanol	83		-		40-160			-
1,1-Dichloroethene	95		-		70-130			-
Tertiary butyl Alcohol	82		-		70-130			-
Methylene chloride	94		-		70-130			-
3-Chloropropene	97		-		70-130			-
Carbon disulfide	81		-		70-130			-
Freon-113	89		-		70-130			-
trans-1,2-Dichloroethene	90		-		70-130			-
1,1-Dichloroethane	90		-		70-130			-
Methyl tert butyl ether	79		-		70-130			-
2-Butanone	94		-		70-130			-
cis-1,2-Dichloroethene	95		-		70-130			-

Lab Control Sample Analysis

Batch Quality Control

Project Name: 822 CLEVELAND AVE - VIA

Lab Number: L2329512

Project Number: 2221723

Report Date: 06/09/23

Parameter	LCS	Qual	LCS	Qual	%Recovery	RPD	Qual	RPD
	%Recovery		%Recovery		Limits			Limits
Volatile Organics in Air - Mansfield Lab Associated sample(s): 01-05 Batch: WG1788971-3								
Ethyl Acetate	87		-		70-130	-		
Chloroform	95		-		70-130	-		
Tetrahydrofuran	91		-		70-130	-		
1,2-Dichloroethane	102		-		70-130	-		
n-Hexane	93		-		70-130	-		
1,1,1-Trichloroethane	113		-		70-130	-		
Benzene	91		-		70-130	-		
Carbon tetrachloride	121		-		70-130	-		
Cyclohexane	93		-		70-130	-		
1,2-Dichloropropane	98		-		70-130	-		
Bromodichloromethane	110		-		70-130	-		
1,4-Dioxane	92		-		70-130	-		
Trichloroethene	90		-		70-130	-		
2,2,4-Trimethylpentane	96		-		70-130	-		
Heptane	104		-		70-130	-		
cis-1,3-Dichloropropene	106		-		70-130	-		
4-Methyl-2-pentanone	108		-		70-130	-		
trans-1,3-Dichloropropene	96		-		70-130	-		
1,1,2-Trichloroethane	97		-		70-130	-		
Toluene	78		-		70-130	-		
2-Hexanone	85		-		70-130	-		
Dibromochloromethane	91		-		70-130	-		
1,2-Dibromoethane	80		-		70-130	-		

Lab Control Sample Analysis

Batch Quality Control

Project Name: 822 CLEVELAND AVE - VIA

Lab Number: L2329512

Project Number: 2221723

Report Date: 06/09/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics in Air - Mansfield Lab Associated sample(s): 01-05 Batch: WG1788971-3								
Tetrachloroethene	70		-		70-130	-		
Chlorobenzene	76		-		70-130	-		
Ethylbenzene	82		-		70-130	-		
p/m-Xylene	84		-		70-130	-		
Bromoform	87		-		70-130	-		
Styrene	79		-		70-130	-		
1,1,2,2-Tetrachloroethane	83		-		70-130	-		
o-Xylene	87		-		70-130	-		
4-Ethyltoluene	78		-		70-130	-		
1,3,5-Trimethylbenzene	84		-		70-130	-		
1,2,4-Trimethylbenzene	89		-		70-130	-		
Benzyl chloride	81		-		70-130	-		
1,3-Dichlorobenzene	78		-		70-130	-		
1,4-Dichlorobenzene	79		-		70-130	-		
1,2-Dichlorobenzene	79		-		70-130	-		
1,2,4-Trichlorobenzene	78		-		70-130	-		
Hexachlorobutadiene	80		-		70-130	-		

Lab Control Sample Analysis

Batch Quality Control

Project Name: 822 CLEVELAND AVE - VIA

Project Number: 2221723

Lab Number: L2329512

Report Date: 06/09/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics in Air by SIM - Mansfield Lab Associated sample(s): 02,04-05 Batch: WG1788974-3								
Vinyl chloride	94		-		70-130	-		25
1,1-Dichloroethene	95		-		70-130	-		25
cis-1,2-Dichloroethene	94		-		70-130	-		25
1,1,1-Trichloroethane	110		-		70-130	-		25
Carbon tetrachloride	119		-		70-130	-		25
Trichloroethene	88		-		70-130	-		25
Tetrachloroethene	71		-		70-130	-		25

Lab Duplicate Analysis

Batch Quality Control

Project Name: 822 CLEVELAND AVE - VIA

Project Number: 2221723

Lab Number: L2329512

Report Date: 06/09/23

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Volatile Organics in Air - Mansfield Lab Associated sample(s): 01-05 QC Batch ID: WG1788971-5 QC Sample: L2329512-04 Client ID: IA-2						
Dichlorodifluoromethane	0.493	0.492	ppbV	0		25
Chloromethane	0.424	0.438	ppbV	3		25
Freon-114	ND	ND	ppbV	NC		25
1,3-Butadiene	ND	ND	ppbV	NC		25
Bromomethane	ND	ND	ppbV	NC		25
Chloroethane	ND	ND	ppbV	NC		25
Ethanol	ND	ND	ppbV	NC		25
Vinyl bromide	ND	ND	ppbV	NC		25
Acetone	2.53	2.42	ppbV	4		25
Trichlorofluoromethane	0.854	0.862	ppbV	1		25
Isopropanol	ND	ND	ppbV	NC		25
Tertiary butyl Alcohol	ND	ND	ppbV	NC		25
Methylene chloride	5.31	5.37	ppbV	1		25
3-Chloropropene	ND	ND	ppbV	NC		25
Carbon disulfide	ND	ND	ppbV	NC		25
Freon-113	ND	ND	ppbV	NC		25
trans-1,2-Dichloroethene	ND	ND	ppbV	NC		25
1,1-Dichloroethane	ND	ND	ppbV	NC		25
Methyl tert butyl ether	ND	ND	ppbV	NC		25
2-Butanone	ND	ND	ppbV	NC		25
Ethyl Acetate	ND	ND	ppbV	NC		25

Lab Duplicate Analysis

Batch Quality Control

Project Name: 822 CLEVELAND AVE - VIA

Project Number: 2221723

Lab Number: L2329512

Report Date: 06/09/23

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Volatile Organics in Air - Mansfield Lab Associated sample(s): 01-05 QC Batch ID: WG1788971-5 QC Sample: L2329512-04 Client ID: IA-2						
Chloroform	0.792	0.819	ppbV	3		25
Tetrahydrofuran	ND	ND	ppbV	NC		25
1,2-Dichloroethane	ND	ND	ppbV	NC		25
n-Hexane	ND	ND	ppbV	NC		25
Benzene	ND	ND	ppbV	NC		25
Cyclohexane	ND	ND	ppbV	NC		25
1,2-Dichloropropane	ND	ND	ppbV	NC		25
Bromodichloromethane	ND	ND	ppbV	NC		25
1,4-Dioxane	ND	ND	ppbV	NC		25
2,2,4-Trimethylpentane	ND	ND	ppbV	NC		25
Heptane	ND	ND	ppbV	NC		25
cis-1,3-Dichloropropene	ND	ND	ppbV	NC		25
4-Methyl-2-pentanone	ND	ND	ppbV	NC		25
trans-1,3-Dichloropropene	ND	ND	ppbV	NC		25
1,1,2-Trichloroethane	ND	ND	ppbV	NC		25
Toluene	ND	ND	ppbV	NC		25
2-Hexanone	ND	ND	ppbV	NC		25
Dibromochloromethane	ND	ND	ppbV	NC		25
1,2-Dibromoethane	ND	ND	ppbV	NC		25
Chlorobenzene	ND	ND	ppbV	NC		25
Ethylbenzene	ND	ND	ppbV	NC		25

Lab Duplicate Analysis

Batch Quality Control

Project Name: 822 CLEVELAND AVE - VIA

Project Number: 2221723

Lab Number: L2329512

Report Date: 06/09/23

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Volatile Organics in Air - Mansfield Lab Associated sample(s): 01-05 QC Batch ID: WG1788971-5 QC Sample: L2329512-04 Client ID: IA-2						
p/m-Xylene	ND	ND	ppbV	NC		25
Bromoform	ND	ND	ppbV	NC		25
Styrene	ND	ND	ppbV	NC		25
1,1,2,2-Tetrachloroethane	ND	ND	ppbV	NC		25
o-Xylene	ND	ND	ppbV	NC		25
4-Ethyltoluene	ND	ND	ppbV	NC		25
1,3,5-Trimethylbenzene	ND	ND	ppbV	NC		25
1,2,4-Trimethylbenzene	ND	ND	ppbV	NC		25
Benzyl chloride	ND	ND	ppbV	NC		25
1,3-Dichlorobenzene	ND	ND	ppbV	NC		25
1,4-Dichlorobenzene	ND	ND	ppbV	NC		25
1,2-Dichlorobenzene	ND	ND	ppbV	NC		25
1,2,4-Trichlorobenzene	ND	ND	ppbV	NC		25
Hexachlorobutadiene	ND	ND	ppbV	NC		25
Volatile Organics in Air by SIM - Mansfield Lab Associated sample(s): 02,04-05 QC Batch ID: WG1788974-5 QC Sample: L2329512-04 Client ID: IA-2						
Vinyl chloride	ND	ND	ppbV	NC		25
1,1-Dichloroethene	ND	ND	ppbV	NC		25
cis-1,2-Dichloroethene	0.044	0.051	ppbV	15		25
1,1,1-Trichloroethane	ND	ND	ppbV	NC		25
Carbon tetrachloride	0.081	0.081	ppbV	0		25
Trichloroethene	0.043	0.043	ppbV	0		25
Tetrachloroethene	0.120	0.120	ppbV	0		25

Project Name: 822 CLEVELAND AVE - VIA

Serial_No:06092313:42
Lab Number: L2329512

Project Number: 2221723

Report Date: 06/09/23

Canister and Flow Controller Information

Samplenum	Client ID	Media ID	Media Type	Date Prepared	Bottle Order	Cleaning Batch ID	Can Leak Check	Initial Pressure (in. Hg)	Pressure on Receipt (in. Hg)	Flow Controller Leak Chk	Flow Out mL/min	Flow In mL/min	% RPD
L2329512-01	SS-1	0961	Flow 4	05/23/23	424495		-	-	-	Pass	4.5	3.8	17
L2329512-01	SS-1	448	2.7L Can	05/23/23	424495	L2326709-01	Pass	-29.6	-12.8	-	-	-	-
L2329512-02	IA-1	01651	Flow 4	05/23/23	424495		-	-	-	Pass	4.5	4.1	9
L2329512-02	IA-1	3191	2.7L Can	05/23/23	424495	L2327203-06	Pass	-29.8	-11.2	-	-	-	-
L2329512-03	SS-2	0471	Flow 4	05/23/23	424495		-	-	-	Pass	4.5	4.3	5
L2329512-03	SS-2	237	2.7L Can	05/23/23	424495	L2327203-06	Pass	-29.6	-8.7	-	-	-	-
L2329512-04	IA-2	01601	Flow 4	05/23/23	424495		-	-	-	Pass	4.5	4.4	2
L2329512-04	IA-2	2044	2.7L Can	05/23/23	424495	L2327203-06	Pass	-29.6	-8.0	-	-	-	-
L2329512-05	OA-1	02086	Flow 4	05/23/23	424495		-	-	-	Pass	4.5	4.6	2
L2329512-05	OA-1	3901	2.7L Can	05/23/23	424495	L2326709-01	Pass	-29.7	-11.8	-	-	-	-

Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2326709
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2326709-01
 Client ID: CAN 208 SHELF 19
 Sample Location:

Date Collected: 05/12/23 18:00
 Date Received: 05/15/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15
 Analytical Date: 05/15/23 20:08
 Analyst: TJS

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Chlorodifluoromethane	ND	0.200	--	ND	0.707	--		1
Propylene	ND	0.500	--	ND	0.861	--		1
Propane	ND	0.500	--	ND	0.902	--		1
Dichlorodifluoromethane	ND	0.200	--	ND	0.989	--		1
Chloromethane	ND	0.200	--	ND	0.413	--		1
Freon-114	ND	0.200	--	ND	1.40	--		1
Methanol	ND	5.00	--	ND	6.55	--		1
Vinyl chloride	ND	0.200	--	ND	0.511	--		1
1,3-Butadiene	ND	0.200	--	ND	0.442	--		1
Butane	ND	0.200	--	ND	0.475	--		1
Bromomethane	ND	0.200	--	ND	0.777	--		1
Chloroethane	ND	0.200	--	ND	0.528	--		1
Ethanol	ND	5.00	--	ND	9.42	--		1
Dichlorofluoromethane	ND	0.200	--	ND	0.842	--		1
Vinyl bromide	ND	0.200	--	ND	0.874	--		1
Acrolein	ND	0.500	--	ND	1.15	--		1
Acetone	ND	1.00	--	ND	2.38	--		1
Acetonitrile	ND	0.200	--	ND	0.336	--		1
Trichlorofluoromethane	ND	0.200	--	ND	1.12	--		1
Isopropanol	ND	0.500	--	ND	1.23	--		1
Acrylonitrile	ND	0.500	--	ND	1.09	--		1
Pentane	ND	0.200	--	ND	0.590	--		1
Ethyl ether	ND	0.200	--	ND	0.606	--		1
1,1-Dichloroethene	ND	0.200	--	ND	0.793	--		1



Project Name: BATCH CANISTER CERTIFICATION
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Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2326709-01
 Client ID: CAN 208 SHELF 19
 Sample Location:

Date Collected: 05/12/23 18:00
 Date Received: 05/15/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--		1
Methylene chloride	ND	0.500	--	ND	1.74	--		1
3-Chloropropene	ND	0.200	--	ND	0.626	--		1
Carbon disulfide	ND	0.200	--	ND	0.623	--		1
Freon-113	ND	0.200	--	ND	1.53	--		1
trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
1,1-Dichloroethane	ND	0.200	--	ND	0.809	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
Vinyl acetate	ND	1.00	--	ND	3.52	--		1
Xylenes, total	ND	0.600	--	ND	0.869	--		1
2-Butanone	ND	0.500	--	ND	1.47	--		1
cis-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
Ethyl Acetate	ND	0.500	--	ND	1.80	--		1
Chloroform	ND	0.200	--	ND	0.977	--		1
Tetrahydrofuran	ND	0.500	--	ND	1.47	--		1
2,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
1,2-Dichloroethane	ND	0.200	--	ND	0.809	--		1
n-Hexane	ND	0.200	--	ND	0.705	--		1
Diisopropyl ether	ND	0.200	--	ND	0.836	--		1
tert-Butyl Ethyl Ether	ND	0.200	--	ND	0.836	--		1
1,2-Dichloroethene (total)	ND	1.00	--	ND	1.00	--		1
1,1,1-Trichloroethane	ND	0.200	--	ND	1.09	--		1
1,1-Dichloropropene	ND	0.200	--	ND	0.908	--		1
Benzene	ND	0.200	--	ND	0.639	--		1
Carbon tetrachloride	ND	0.200	--	ND	1.26	--		1
Cyclohexane	ND	0.200	--	ND	0.688	--		1
tert-Amyl Methyl Ether	ND	0.200	--	ND	0.836	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2326709
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2326709-01
 Client ID: CAN 208 SHELF 19
 Sample Location:

Date Collected: 05/12/23 18:00
 Date Received: 05/15/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Dibromomethane	ND	0.200	--	ND	1.42	--		1
1,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
Bromodichloromethane	ND	0.200	--	ND	1.34	--		1
1,4-Dioxane	ND	0.200	--	ND	0.721	--		1
Trichloroethene	ND	0.200	--	ND	1.07	--		1
2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--		1
Methyl Methacrylate	ND	0.500	--	ND	2.05	--		1
Heptane	ND	0.200	--	ND	0.820	--		1
cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Toluene	ND	0.200	--	ND	0.754	--		1
1,3-Dichloropropane	ND	0.200	--	ND	0.924	--		1
2-Hexanone	ND	0.200	--	ND	0.820	--		1
Dibromochloromethane	ND	0.200	--	ND	1.70	--		1
1,2-Dibromoethane	ND	0.200	--	ND	1.54	--		1
Butyl acetate	ND	0.500	--	ND	2.38	--		1
Octane	ND	0.200	--	ND	0.934	--		1
Tetrachloroethene	ND	0.200	--	ND	1.36	--		1
1,1,1,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1
Chlorobenzene	ND	0.200	--	ND	0.921	--		1
Ethylbenzene	ND	0.200	--	ND	0.869	--		1
p/m-Xylene	ND	0.400	--	ND	1.74	--		1
Bromoform	ND	0.200	--	ND	2.07	--		1
Styrene	ND	0.200	--	ND	0.852	--		1
1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2326709
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2326709-01
 Client ID: CAN 208 SHELF 19
 Sample Location:

Date Collected: 05/12/23 18:00
 Date Received: 05/15/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
o-Xylene	ND	0.200	--	ND	0.869	--		1
1,2,3-Trichloropropane	ND	0.200	--	ND	1.21	--		1
Nonane	ND	0.200	--	ND	1.05	--		1
Isopropylbenzene	ND	0.200	--	ND	0.983	--		1
Bromobenzene	ND	0.200	--	ND	0.793	--		1
2-Chlorotoluene	ND	0.200	--	ND	1.04	--		1
n-Propylbenzene	ND	0.200	--	ND	0.983	--		1
4-Chlorotoluene	ND	0.200	--	ND	1.04	--		1
4-Ethyltoluene	ND	0.200	--	ND	0.983	--		1
1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
tert-Butylbenzene	ND	0.200	--	ND	1.10	--		1
1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
Decane	ND	0.200	--	ND	1.16	--		1
Benzyl chloride	ND	0.200	--	ND	1.04	--		1
1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
sec-Butylbenzene	ND	0.200	--	ND	1.10	--		1
p-Isopropyltoluene	ND	0.200	--	ND	1.10	--		1
1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
n-Butylbenzene	ND	0.200	--	ND	1.10	--		1
1,2-Dibromo-3-chloropropane	ND	0.200	--	ND	1.93	--		1
Undecane	ND	0.200	--	ND	1.28	--		1
Dodecane	ND	0.200	--	ND	1.39	--		1
1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Naphthalene	ND	0.200	--	ND	1.05	--		1
1,2,3-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Hexachlorobutadiene	ND	0.200	--	ND	2.13	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2326709
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2326709-01
 Client ID: CAN 208 SHELF 19
 Sample Location:

Date Collected: 05/12/23 18:00
 Date Received: 05/15/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								

Results	Qualifier	Units	RDL	Dilution Factor
Tentatively Identified Compounds				

No Tentatively Identified Compounds

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-Difluorobenzene	96		60-140
Bromochloromethane	97		60-140
chlorobenzene-d5	96		60-140



Project Name: BATCH CANISTER CERTIFICATION
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Lab Number: L2326709
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2326709-01
 Client ID: CAN 208 SHELF 19
 Sample Location:

Date Collected: 05/12/23 18:00
 Date Received: 05/15/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15-SIM
 Analytical Date: 05/15/23 20:08
 Analyst: TJS

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Dichlorodifluoromethane	ND	0.200	--	ND	0.989	--		1
Chloromethane	ND	0.200	--	ND	0.413	--		1
Freon-114	ND	0.050	--	ND	0.349	--		1
Vinyl chloride	ND	0.020	--	ND	0.051	--		1
1,3-Butadiene	ND	0.020	--	ND	0.044	--		1
Bromomethane	ND	0.020	--	ND	0.078	--		1
Chloroethane	ND	0.100	--	ND	0.264	--		1
Acrolein	ND	0.050	--	ND	0.115	--		1
Acetone	ND	1.00	--	ND	2.38	--		1
Trichlorofluoromethane	ND	0.050	--	ND	0.281	--		1
Acrylonitrile	ND	0.500	--	ND	1.09	--		1
1,1-Dichloroethene	ND	0.020	--	ND	0.079	--		1
Methylene chloride	ND	0.500	--	ND	1.74	--		1
Freon-113	ND	0.050	--	ND	0.383	--		1
trans-1,2-Dichloroethene	ND	0.020	--	ND	0.079	--		1
1,1-Dichloroethane	ND	0.020	--	ND	0.081	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
2-Butanone	ND	0.500	--	ND	1.47	--		1
cis-1,2-Dichloroethene	ND	0.020	--	ND	0.079	--		1
Chloroform	ND	0.020	--	ND	0.098	--		1
1,2-Dichloroethane	ND	0.020	--	ND	0.081	--		1
1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--		1
Benzene	ND	0.100	--	ND	0.319	--		1
Carbon tetrachloride	ND	0.020	--	ND	0.126	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2326709
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2326709-01
 Client ID: CAN 208 SHELF 19
 Sample Location:

Date Collected: 05/12/23 18:00
 Date Received: 05/15/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,2-Dichloropropane	ND	0.020	--	ND	0.092	--		1
Bromodichloromethane	ND	0.020	--	ND	0.134	--		1
1,4-Dioxane	ND	0.100	--	ND	0.360	--		1
Trichloroethene	ND	0.020	--	ND	0.107	--		1
cis-1,3-Dichloropropene	ND	0.020	--	ND	0.091	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.020	--	ND	0.091	--		1
1,1,2-Trichloroethane	ND	0.020	--	ND	0.109	--		1
Toluene	ND	0.100	--	ND	0.377	--		1
Dibromochloromethane	ND	0.020	--	ND	0.170	--		1
1,2-Dibromoethane	ND	0.020	--	ND	0.154	--		1
Tetrachloroethene	ND	0.020	--	ND	0.136	--		1
1,1,1,2-Tetrachloroethane	ND	0.020	--	ND	0.137	--		1
Chlorobenzene	ND	0.100	--	ND	0.461	--		1
Ethylbenzene	ND	0.020	--	ND	0.087	--		1
p/m-Xylene	ND	0.040	--	ND	0.174	--		1
Bromoform	ND	0.020	--	ND	0.207	--		1
Styrene	ND	0.020	--	ND	0.085	--		1
1,1,2,2-Tetrachloroethane	ND	0.020	--	ND	0.137	--		1
o-Xylene	ND	0.020	--	ND	0.087	--		1
Isopropylbenzene	ND	0.200	--	ND	0.983	--		1
4-Ethyltoluene	ND	0.020	--	ND	0.098	--		1
1,3,5-Trimethylbenzene	ND	0.020	--	ND	0.098	--		1
1,2,4-Trimethylbenzene	ND	0.020	--	ND	0.098	--		1
Benzyl chloride	ND	0.100	--	ND	0.518	--		1
1,3-Dichlorobenzene	ND	0.020	--	ND	0.120	--		1
1,4-Dichlorobenzene	ND	0.020	--	ND	0.120	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2326709
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2326709-01
 Client ID: CAN 208 SHELF 19
 Sample Location:

Date Collected: 05/12/23 18:00
 Date Received: 05/15/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
sec-Butylbenzene	ND	0.200	--	ND	1.10	--		1
p-Isopropyltoluene	ND	0.200	--	ND	1.10	--		1
1,2-Dichlorobenzene	ND	0.020	--	ND	0.120	--		1
n-Butylbenzene	ND	0.200	--	ND	1.10	--		1
1,2,4-Trichlorobenzene	ND	0.050	--	ND	0.371	--		1
Naphthalene	ND	0.050	--	ND	0.262	--		1
1,2,3-Trichlorobenzene	ND	0.050	--	ND	0.371	--		1
Hexachlorobutadiene	ND	0.050	--	ND	0.533	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	95		60-140
bromochloromethane	99		60-140
chlorobenzene-d5	95		60-140



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2327203
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2327203-06
 Client ID: CAN 3026 SHELF 21
 Sample Location:

Date Collected: 05/17/23 09:00
 Date Received: 05/17/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15
 Analytical Date: 05/18/23 19:47
 Analyst: RAY

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Chlorodifluoromethane	ND	0.200	--	ND	0.707	--		1
Propylene	ND	0.500	--	ND	0.861	--		1
Propane	ND	0.500	--	ND	0.902	--		1
Dichlorodifluoromethane	ND	0.200	--	ND	0.989	--		1
Chloromethane	ND	0.200	--	ND	0.413	--		1
Freon-114	ND	0.200	--	ND	1.40	--		1
Methanol	ND	5.00	--	ND	6.55	--		1
Vinyl chloride	ND	0.200	--	ND	0.511	--		1
1,3-Butadiene	ND	0.200	--	ND	0.442	--		1
Butane	ND	0.200	--	ND	0.475	--		1
Bromomethane	ND	0.200	--	ND	0.777	--		1
Chloroethane	ND	0.200	--	ND	0.528	--		1
Ethanol	ND	5.00	--	ND	9.42	--		1
Dichlorofluoromethane	ND	0.200	--	ND	0.842	--		1
Vinyl bromide	ND	0.200	--	ND	0.874	--		1
Acrolein	ND	0.500	--	ND	1.15	--		1
Acetone	ND	1.00	--	ND	2.38	--		1
Acetonitrile	ND	0.200	--	ND	0.336	--		1
Trichlorofluoromethane	ND	0.200	--	ND	1.12	--		1
Isopropanol	ND	0.500	--	ND	1.23	--		1
Acrylonitrile	ND	0.500	--	ND	1.09	--		1
Pentane	ND	0.200	--	ND	0.590	--		1
Ethyl ether	ND	0.200	--	ND	0.606	--		1
1,1-Dichloroethene	ND	0.200	--	ND	0.793	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2327203
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2327203-06
 Client ID: CAN 3026 SHELF 21
 Sample Location:

Date Collected: 05/17/23 09:00
 Date Received: 05/17/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--		1
Methylene chloride	ND	0.500	--	ND	1.74	--		1
3-Chloropropene	ND	0.200	--	ND	0.626	--		1
Carbon disulfide	ND	0.200	--	ND	0.623	--		1
Freon-113	ND	0.200	--	ND	1.53	--		1
trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
1,1-Dichloroethane	ND	0.200	--	ND	0.809	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
Vinyl acetate	ND	1.00	--	ND	3.52	--		1
2-Butanone	ND	0.500	--	ND	1.47	--		1
Xylenes, total	ND	0.600	--	ND	0.869	--		1
cis-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--		1
Ethyl Acetate	ND	0.500	--	ND	1.80	--		1
Chloroform	ND	0.200	--	ND	0.977	--		1
Tetrahydrofuran	ND	0.500	--	ND	1.47	--		1
2,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
1,2-Dichloroethane	ND	0.200	--	ND	0.809	--		1
n-Hexane	ND	0.200	--	ND	0.705	--		1
Diisopropyl ether	ND	0.200	--	ND	0.836	--		1
tert-Butyl Ethyl Ether	ND	0.200	--	ND	0.836	--		1
1,2-Dichloroethene (total)	ND	1.00	--	ND	1.00	--		1
1,1,1-Trichloroethane	ND	0.200	--	ND	1.09	--		1
1,1-Dichloropropene	ND	0.200	--	ND	0.908	--		1
Benzene	ND	0.200	--	ND	0.639	--		1
Carbon tetrachloride	ND	0.200	--	ND	1.26	--		1
Cyclohexane	ND	0.200	--	ND	0.688	--		1
tert-Amyl Methyl Ether	ND	0.200	--	ND	0.836	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2327203
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2327203-06
 Client ID: CAN 3026 SHELF 21
 Sample Location:

Date Collected: 05/17/23 09:00
 Date Received: 05/17/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
Dibromomethane	ND	0.200	--	ND	1.42	--		1
1,2-Dichloropropane	ND	0.200	--	ND	0.924	--		1
Bromodichloromethane	ND	0.200	--	ND	1.34	--		1
1,4-Dioxane	ND	0.200	--	ND	0.721	--		1
Trichloroethene	ND	0.200	--	ND	1.07	--		1
2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--		1
Methyl Methacrylate	ND	0.500	--	ND	2.05	--		1
Heptane	ND	0.200	--	ND	0.820	--		1
cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--		1
1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--		1
Toluene	ND	0.200	--	ND	0.754	--		1
1,3-Dichloropropane	ND	0.200	--	ND	0.924	--		1
2-Hexanone	ND	0.200	--	ND	0.820	--		1
Dibromochloromethane	ND	0.200	--	ND	1.70	--		1
1,2-Dibromoethane	ND	0.200	--	ND	1.54	--		1
Butyl acetate	ND	0.500	--	ND	2.38	--		1
Octane	ND	0.200	--	ND	0.934	--		1
Tetrachloroethene	ND	0.200	--	ND	1.36	--		1
1,1,1,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1
Chlorobenzene	ND	0.200	--	ND	0.921	--		1
Ethylbenzene	ND	0.200	--	ND	0.869	--		1
p/m-Xylene	ND	0.400	--	ND	1.74	--		1
Bromoform	ND	0.200	--	ND	2.07	--		1
Styrene	ND	0.200	--	ND	0.852	--		1
1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2327203
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2327203-06
 Client ID: CAN 3026 SHELF 21
 Sample Location:

Date Collected: 05/17/23 09:00
 Date Received: 05/17/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								
o-Xylene	ND	0.200	--	ND	0.869	--		1
1,2,3-Trichloropropane	ND	0.200	--	ND	1.21	--		1
Nonane	ND	0.200	--	ND	1.05	--		1
Isopropylbenzene	ND	0.200	--	ND	0.983	--		1
Bromobenzene	ND	0.200	--	ND	0.793	--		1
2-Chlorotoluene	ND	0.200	--	ND	1.04	--		1
n-Propylbenzene	ND	0.200	--	ND	0.983	--		1
4-Chlorotoluene	ND	0.200	--	ND	1.04	--		1
4-Ethyltoluene	ND	0.200	--	ND	0.983	--		1
1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
tert-Butylbenzene	ND	0.200	--	ND	1.10	--		1
1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--		1
Decane	ND	0.200	--	ND	1.16	--		1
Benzyl chloride	ND	0.200	--	ND	1.04	--		1
1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
sec-Butylbenzene	ND	0.200	--	ND	1.10	--		1
p-Isopropyltoluene	ND	0.200	--	ND	1.10	--		1
1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--		1
n-Butylbenzene	ND	0.200	--	ND	1.10	--		1
1,2-Dibromo-3-chloropropane	ND	0.200	--	ND	1.93	--		1
Undecane	ND	0.200	--	ND	1.28	--		1
Dodecane	ND	0.200	--	ND	1.39	--		1
1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Naphthalene	ND	0.200	--	ND	1.05	--		1
1,2,3-Trichlorobenzene	ND	0.200	--	ND	1.48	--		1
Hexachlorobutadiene	ND	0.200	--	ND	2.13	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2327203
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2327203-06
 Client ID: CAN 3026 SHELF 21
 Sample Location:

Date Collected: 05/17/23 09:00
 Date Received: 05/17/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air - Mansfield Lab								

Results	Qualifier	Units	RDL	Dilution Factor
Tentatively Identified Compounds				

No Tentatively Identified Compounds

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-Difluorobenzene	88		60-140
Bromochloromethane	93		60-140
chlorobenzene-d5	91		60-140



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2327203
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2327203-06
 Client ID: CAN 3026 SHELF 21
 Sample Location:

Date Collected: 05/17/23 09:00
 Date Received: 05/17/23
 Field Prep: Not Specified

Sample Depth:
 Matrix: Air
 Analytical Method: 48,TO-15-SIM
 Analytical Date: 05/18/23 19:47
 Analyst: RAY

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
Dichlorodifluoromethane	ND	0.200	--	ND	0.989	--		1
Chloromethane	ND	0.200	--	ND	0.413	--		1
Freon-114	ND	0.050	--	ND	0.349	--		1
Vinyl chloride	ND	0.020	--	ND	0.051	--		1
1,3-Butadiene	ND	0.020	--	ND	0.044	--		1
Bromomethane	ND	0.020	--	ND	0.078	--		1
Chloroethane	ND	0.100	--	ND	0.264	--		1
Acrolein	ND	0.050	--	ND	0.115	--		1
Acetone	ND	1.00	--	ND	2.38	--		1
Trichlorofluoromethane	ND	0.050	--	ND	0.281	--		1
Acrylonitrile	ND	0.500	--	ND	1.09	--		1
1,1-Dichloroethene	ND	0.020	--	ND	0.079	--		1
Methylene chloride	ND	0.500	--	ND	1.74	--		1
Freon-113	ND	0.050	--	ND	0.383	--		1
trans-1,2-Dichloroethene	ND	0.020	--	ND	0.079	--		1
1,1-Dichloroethane	ND	0.020	--	ND	0.081	--		1
Methyl tert butyl ether	ND	0.200	--	ND	0.721	--		1
2-Butanone	ND	0.500	--	ND	1.47	--		1
cis-1,2-Dichloroethene	ND	0.020	--	ND	0.079	--		1
Chloroform	ND	0.020	--	ND	0.098	--		1
1,2-Dichloroethane	ND	0.020	--	ND	0.081	--		1
1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--		1
Benzene	ND	0.100	--	ND	0.319	--		1
Carbon tetrachloride	ND	0.020	--	ND	0.126	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2327203
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2327203-06
 Client ID: CAN 3026 SHELF 21
 Sample Location:

Date Collected: 05/17/23 09:00
 Date Received: 05/17/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
1,2-Dichloropropane	ND	0.020	--	ND	0.092	--		1
Bromodichloromethane	ND	0.020	--	ND	0.134	--		1
1,4-Dioxane	ND	0.100	--	ND	0.360	--		1
Trichloroethene	ND	0.020	--	ND	0.107	--		1
cis-1,3-Dichloropropene	ND	0.020	--	ND	0.091	--		1
4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--		1
trans-1,3-Dichloropropene	ND	0.020	--	ND	0.091	--		1
1,1,2-Trichloroethane	ND	0.020	--	ND	0.109	--		1
Toluene	ND	0.100	--	ND	0.377	--		1
Dibromochloromethane	ND	0.020	--	ND	0.170	--		1
1,2-Dibromoethane	ND	0.020	--	ND	0.154	--		1
Tetrachloroethene	ND	0.020	--	ND	0.136	--		1
1,1,1,2-Tetrachloroethane	ND	0.020	--	ND	0.137	--		1
Chlorobenzene	ND	0.100	--	ND	0.461	--		1
Ethylbenzene	ND	0.020	--	ND	0.087	--		1
p/m-Xylene	ND	0.040	--	ND	0.174	--		1
Bromoform	ND	0.020	--	ND	0.207	--		1
Styrene	ND	0.020	--	ND	0.085	--		1
1,1,2,2-Tetrachloroethane	ND	0.020	--	ND	0.137	--		1
o-Xylene	ND	0.020	--	ND	0.087	--		1
Isopropylbenzene	ND	0.200	--	ND	0.983	--		1
4-Ethyltoluene	ND	0.020	--	ND	0.098	--		1
1,3,5-Trimethylbenzene	ND	0.020	--	ND	0.098	--		1
1,2,4-Trimethylbenzene	ND	0.020	--	ND	0.098	--		1
Benzyl chloride	ND	0.100	--	ND	0.518	--		1
1,3-Dichlorobenzene	ND	0.020	--	ND	0.120	--		1
1,4-Dichlorobenzene	ND	0.020	--	ND	0.120	--		1



Project Name: BATCH CANISTER CERTIFICATION
Project Number: CANISTER QC BAT

Lab Number: L2327203
Report Date: 06/09/23

Air Canister Certification Results

Lab ID: L2327203-06
 Client ID: CAN 3026 SHELF 21
 Sample Location:

Date Collected: 05/17/23 09:00
 Date Received: 05/17/23
 Field Prep: Not Specified

Sample Depth:

Parameter	ppbV			ug/m3			Qualifier	Dilution Factor
	Results	RL	MDL	Results	RL	MDL		
Volatile Organics in Air by SIM - Mansfield Lab								
p-Isopropyltoluene	ND	0.200	--	ND	1.10	--		1
1,2-Dichlorobenzene	ND	0.020	--	ND	0.120	--		1
n-Butylbenzene	ND	0.200	--	ND	1.10	--		1
1,2,4-Trichlorobenzene	ND	0.050	--	ND	0.371	--		1
Naphthalene	ND	0.050	--	ND	0.262	--		1
1,2,3-Trichlorobenzene	ND	0.050	--	ND	0.371	--		1
Hexachlorobutadiene	ND	0.050	--	ND	0.533	--		1

Internal Standard	% Recovery	Qualifier	Acceptance Criteria
1,4-difluorobenzene	106		60-140
bromochloromethane	109		60-140
chlorobenzene-d5	105		60-140



Project Name: 822 CLEVELAND AVE - VIA**Lab Number:** L2329512**Project Number:** 2221723**Report Date:** 06/09/23**Sample Receipt and Container Information**

Were project specific reporting limits specified?

YES

Cooler Information

Cooler	Custody Seal
NA	Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2329512-01A	Canister - 2.7 Liter	NA	NA			Y	Absent		TO15-LL(30)
L2329512-02A	Canister - 2.7 Liter	NA	NA			Y	Absent		TO15-LL(30),TO15-SIM(30)
L2329512-03A	Canister - 2.7 Liter	NA	NA			Y	Absent		TO15-LL(30)
L2329512-04A	Canister - 2.7 Liter	NA	NA			Y	Absent		TO15-LL(30),TO15-SIM(30)
L2329512-05A	Canister - 2.7 Liter	NA	NA			Y	Absent		TO15-LL(30),TO15-SIM(30)

Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.) Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: Data Usability Report



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA, this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

- A** - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- F** - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.
- G** - The concentration may be biased high due to matrix interferences (i.e. co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- J** - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

Report Format: Data Usability Report



Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

Data Qualifiers

- ND** - Not detected at the reporting limit (RL) for the sample.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.
- V** - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)
- Z** - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Project Name: 822 CLEVELAND AVE - VIA
Project Number: 2221723

Lab Number: L2329512
Report Date: 06/09/23

REFERENCES

- 48 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. Second Edition. EPA/625/R-96/010b, January 1999.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.



Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility

EPA 624/624.1: m/p-xylene, o-xylene, Naphthalene

EPA 625/625.1: alpha-Terpeneol

EPA 8260C/8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.

EPA 8270D/8270E: NPW: Dimethylnaphthalene, 1,4-Diphenylhydrazine, alpha-Terpeneol; SCM: Dimethylnaphthalene, 1,4-Diphenylhydrazine.

SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO₂, NO₃.

Mansfield Facility

SM 2540D: TSS

EPA 8082A: NPW: PCB: 1, 5, 31, 87,101, 110, 141, 151, 153, 180, 183, 187.

EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene,

3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water

EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE,**

EPA 180.1, SM2130B, SM4500CI-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B

EPA 332: Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.

Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, SM9222D.**

Non-Potable Water

SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1:**

Ammonia-N, **LCHAT 10-107-06-1-B:** Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2:** Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E,**

SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.

EPA 624.1: Volatile Halocarbons & Aromatics,

EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II,

Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs

EPA 625.1: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045:** PCB-Oil.

Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603, SM9222D.**

Mansfield Facility:

Drinking Water

EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1 Hg.**

EPA 522, EPA 537.1.

Non-Potable Water

EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.

EPA 200.8: Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.

EPA 245.1 Hg.

SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.



AIR ANALYSIS

CHAIN OF CUSTODY

PAGE (1) OF (1)

Date Rec'd in Lab: 5/26/23

ALPHA Job #: L2329512

320 Forbes Blvd, Mansfield, MA 02048
TEL: 508-822-9300 FAX: 508-822-3288

Client Information

Client: *Labella Associates*
Address: *300 Pearl Street
Buffalo NY*
Phone:
Fax:
Email: *ckibler@labellape.com*

These samples have been previously analyzed by Alpha

Other Project Specific Requirements/Comments:

Project-Specific Target Compound List:

Project Information

Project Name: *822 Cleveland Ave-VIA*
Project Location: *Niagara Falls NY*
Project #: *2221723*
Project Manager: *Chris Kibler*
ALPHA Quote #:

Turn-Around Time

Standard RUSH (only confirmed if pre-approved)

Date Due: Time:

Report Information - Data Deliverables

FAX
 ADEx
Criteria Checker:
(Default based on Regulatory Criteria Indicated)
Other Formats:
 EMAIL (standard pdf report)
 Additional Deliverables:
Report to: (if different than Project Manager)

Billing Information

Same as Client info PO #:

Regulatory Requirements/Report Limits

State/Fed Program Res / Comm

ANALYSIS

TO-15
TO-15 SIM
APH (Subtract from petroleum HCs)
Fixed Gases
Sulfides & Mercaptans by TO-15

All Columns Below Must Be Filled Out

ALPHA Lab ID (Lab Use Only)	Sample ID	COLLECTION					Sample Matrix*	Sampler's Initials	Can Size	ID Can	ID - Flow Controller	TO-15	TO-15 SIM	APH (Subtract from petroleum HCs)	Fixed Gases	Sulfides & Mercaptans by TO-15	Sample Comments (i.e. PID)	
		End Date	Start Time	End Time	Initial Vacuum	Final Vacuum												
29512-01	SS-1	5/25/23	0830	1536	-30.15	SV	-17.66	(AB)	2.7L	448	0981	X						
02	IA-1	↓	0831	1537	-30.25	AA	-11.04	↓	↓	3191	01851	X						
03	SS-2		0854	1539	-30.19	SV	-8.42			237	0471	X						
04	IA-2		0835	1538	-30.20	AA	7.83			2044	01601	X						
05	OA-1		0837	1535	-29.86	AA	-10.95			3901	02066	X						

(AB)

***SAMPLE MATRIX CODES**

AA = Ambient Air (Indoor/Outdoor)
SV = Soil Vapor/Landfill Gas/SVE
Other = Please Specify

Container Type

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

Relinquished By:

Date/Time

Received By:

Date/Time:

Chris Kibler
5/26/23

5/25/23 1609
5/25/23 1605
300
5/26/23 0615

W. H. ...
R. ...

5/25/23 1603
5/26/23 0040
5/26/23 0700
5/26/23 0615

April 23, 2020

Niagara University
Mr. Daniel McMann
5795 Lewiston Road
Niagara University, New York 14109

**Re: Pre-Renovation Asbestos, Lead-Based Paint and PCB Inspection
822 Cleveland Avenue
Niagara Falls, New York**

- **Original 1850's Basement and Exterior Windows**
- **1900's Addition Basement, Sunday School Room, Music Office and Exterior Windows**

Dear Ms. McMann:

Enclosed please find a copy of the Pre-Renovation Asbestos Inspection Report for the above-referenced property. Consistent with the requirements of NYS Industrial Code Rule 56; Subpart 56-5.1(g)(1), if a building permit is required for the planned Renovations/Addition, a copy of the Inspection Report must be forwarded as follows:

"One (1) copy of the completed asbestos survey shall be sent by the owner or their agent to the local government entity charged with issuing a permit for such demolition, renovation, remodeling or repair work under applicable State or local laws."

Thank you for the opportunity to be of service to Niagara University.

Sincerely,
Stohl Environmental, LLC.



Connor Crilly
Project Manager

**Pre-Renovation Asbestos, Lead-Based Paint and PCB Inspection
of**

**822 Cleveland Avenue
Niagara Falls, New York**

Original 1850's Basement and Exterior Windows

**1900's Addition Basement, Sunday School Room, Music Office and
Exterior Windows**



Prepared for:

**Niagara University
5795 Lewiston Road
Niagara University, New York 14109**

Prepared by



**3860 California Road, Orchard Park, New York 14127
PHONE (716) 312-0070 FAX (716) 312-8092
WWW.STOHLENVIRONMENTAL.COM**

Conditions as of April 10, 2020

SUMMARY TABULATION

I. Asbestos Inspection

- 1.1. Introduction
- 1.2. Executive Summary
- 1.3. Purpose
- 1.4. Methodology
- 1.5. Homogenous Area Numbers (HAN) and Sample Results

II. Lead-Based Paint Inspection

- 2.1. Introduction
- 2.2. Methodology
- 2.3. Lead-Based Paint Inspection Report
- 2.4. XRF Spectrum Analyzer Report

III. PCB's in Building Caulks and Sealants

- 3.1. Introduction
- 3.2. Background
- 3.3. Methodology
- 3.4. Inspection Report
- 3.5. PCB Analysis Report

APPENDIX

- A. Floor Plans
- B. Site Photos
- C. General Conditions of Inspection
- D. Certifications and Licenses
- E. Laboratory Report and Chain of Custody

1. Introduction

Stohl Environmental, LLC was retained by the Niagara University to inspect the structure located at 822 Cleveland Avenue in Niagara Falls, New York for the presence of asbestos containing building materials (ACBM) in areas of planned renovations including:

- The Original 1850's basement and exterior windows
- The 1900's Additions in the basement, Sunday school room and exterior windows

Stohl Environmental, LLC was charged with locating suspect asbestos containing materials, sampling of these materials to ascertain asbestos content, and identifying the locations and estimated quantities of the confirmed asbestos containing materials.

Stohl Environmental, LLC is prepared to develop a specification and contract documents for the removal of these materials at the request of the client. The information following this introduction details the amount of asbestos present in this facility and the location of the asbestos containing building materials (ACBM).

Although the report is a comprehensive analysis of the asbestos inspection work performed, it would be helpful to review all applicable federal, state and local rules, laws and regulations regarding the handling and treatment of asbestos containing building materials (ACBM). The following is a list of suggested reading and information sources relating to asbestos:

- * New York State Department of Labor Industrial Code Rule 56
- * National Emission Standard for Hazardous Air Pollutants "NESHAPS" (40 CFR 61)
- * Occupational Safety and Health Administration (OSHA 1926.1101, 1910.134, 1910.1020, 1910.1200, 1910.145, 1910.95, 1926.58)
- * Environmental Protection Agency rule CFR 763.46 Asbestos Hazard Emergency Response Act

2. Executive Summary

The scope of services included the identification of suspect asbestos containing building materials in preparation for building renovation, sampling and analysis of the suspect materials, and approximate quantity of confirmed asbestos containing materials.

The inspection was conducted on April 10, 2020 and revealed the following materials as suspected of containing asbestos:

HAN	Description
100B	1850's Plaster Skim Coat - Grey
100C	1850'S Plaster Base Coat
101A	1900's Plaster Skim Coat - White
101B	1900's Plaster Base Coat - Grey
102	Drywall
102A	Joint Compound
103	Drywall Lathe
200	1850's Plaster Skim Coat - White
201	Textured Ceiling Materials
300	12"x12" Floor Tile - Red
300A	12"x12" Floor Tile Mastic - Yellow
301	12"x12" Floor Tile White w/ Streaks
301A	12"x12" Floor Tile Mastic - White
302	Floor Tile Vapor Barrier
303	12"x12" Floor Tile - Yellow
303A	12"x12" Yellow Floor Tile Mastic - Yellow
304	12"x12" Floor Tile - Beige w/ Streaks
304A	12"x12" Floor Tile Mastic - Black
305	Linoleum Green Square Pattern
306	Linoleum Flower Pattern Square
307	Linoleum Mastic - Yellow
309	Linoleum Star Pattern
310	Linoleum Brick Pattern
311	Linoleum Mastic - Brown
400	Mudded Pipe Elbow Insulation
401	Air Cell Pipe Insulation
402	Magnesia Pipe Insulation
600	Sink Insulation
601	Electrical Panel Heat Shield

2. Executive Summary

HAN	Description
602	Fire Door Insulation
603	1850's Window Caulk
604	1850's Window Glazing
605	Addition Window Caulk
606	Addition Window Glazing
700	Field Felt
701	Flashing Felt
703	Roof Deck
705	Repair Tar
706	Hot Mop
707	Roof Caulk

Bulk sampling and laboratory analysis of the suspect asbestos containing materials by the Polarized Light Microscopy (PLM) and, where necessary, Transmission Electron Microscopy (TEM) methods, revealed the following materials as asbestos containing building materials (ACBM):

HAN	Material Description and Approximate Location	Friability / Condition NOTE 1	Approximate Quantity NOTE 2
300	12"x12" Floor Tile - Red – Open Sitting Area, Office 2, Office 3	NF/I	900 ft ²
303	12"x12" Floor Tile - Yellow - Kitchen	NF/I	415 ft ²
305	Linoleum Green Square Pattern – Bathroom 1	NF/I	Included in HAN 307
306	Linoleum Flower Pattern Square- Adhered to HAN 307 in Bathroom 2 – Note 3	NF/I	Included in HAN 307
307	Linoleum Mastic - Yellow – Bathroom 1, Bathroom 2, Hall 2	NF/I	305 ft ²
310	Linoleum Brick Pattern – Adhered to HAN 307 in Hall 2 – Note 3	NF/I	Included in HAN 307
400	Mudded Pipe Elbow Insulation – Boiler Storage, Boiler, Office Storage, Open Sitting Area, Stage, Office 2, Office 3, Office 4, Office 5, Meeting Room, Hallway 1, Kitchen	F/I	75 ft ²
401	Air Cell Pipe Insulation - Boiler Storage, Boiler, Office Storage, Open Sitting Area, Stage, Office 2, Office 3, Office 4, Office 5, Meeting Room, Hallway 1, Kitchen	F/I	250 lf
402	Magnesia Pipe Insulation – Boiler Room	F/I	25 lf
600	Sink Insulation – Kitchen Note 3	NF/I	<10 ft ²
601	Electrical Panel Heat Shield – Hallway 1 Note 3	F/I	<10 ft ²
602	Fire Door Insulation – Boiler Room Note 3	F/I	1 Door
603	1850's Window Caulk – All Original Exterior Windows	NF/I	<10 ft ²
604	1850's Window Glazing – All Original Exterior Windows	NF/I	<10 ft ²
700	Field Felt – Addition Flat Roof under Rubber Roof System	NF/I	2,700 ft ²
701	Flashing Felt - Addition Flat Roof along the perimeter of the roof and at roof top unit and penetrations under Rubber Roof System.	NF/I	Included in HAN 700
705	Repair Tar – Located on Parapet walls, seams of metal end caps on parapet walls, along the perimeter of flashing, and repairs, penetrations, and roof top units	NF/I	<10 ft ²

2. Executive Summary (Continued)

Notes to Executive Summary

- Note 1:** Friability/Condition:
F=Friable: a material that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure, or is capable of being released into the air by hand pressure.
NF=Non Friable: a material that when dry cannot be crumbled, pulverized, or reduced to hand pressure, and is not capable of being released into the air by hand pressure.
I=Intact: Asbestos material that has not crumbled, been pulverized, or otherwise been damaged or disturbed, and the material's matrix has not noticeably deteriorated.
D=Damaged: Asbestos material that has deteriorated or sustained physical injury demonstrated by separation of the ACM into layers, separation of the ACM from the substrate, flaking, blistering, crumbling, water damage, scrapes, gouges, or other signs of physical injury.
SD=Significantly Damaged: Damaged asbestos where the damage is extensive and severe.
- Note 2:** Quantities are approximate, and are only associated with the areas of planned renovation. Additional asbestos containing materials may be located outside areas of planned renovation that were not surveyed, assessed or quantified during this inspection.
- Note 3:** This material was assumed to contain asbestos based on Stohl Environmental's experience on similar projects or because the material was adhered to another asbestos containing material (or adjacent to other materials needing abatement) and must be managed as such.

3. Purpose

The purpose of the asbestos inspection was to identify and quantify the types of asbestos containing building materials (ACBM) in the facility in areas of planned renovations. Samples of the suspect materials were collected for analysis by an independent laboratory and the condition of each material noted in relation to its potential to be disturbed during normal operations. The potential for fiber release was also considered.

The report is generated for the exclusive use of Niagara University and/or its representatives or agents and documents the inspection work, sampling and analysis performed. The report is not designed to serve as a specification for abatement.

4. Methodology for Inspection

All work performed by Stohl Environmental was conducted in accordance with applicable regulations including New York State Department of Labor standards 12 NYCRR Part 56, National Emission Standards for Hazardous Air Pollutants (NESHAPS), and Occupational Safety and Health Administration regulations 29 CFR 1910.1101 and 29 CFR 1910.134. All Stohl Environmental personnel assigned to conduct inspections have completed the Environmental Protection Agency (EPA) required training and New York State Department of Labor Division of Safety and Health certification program.

Each suspect asbestos containing building material (ACBM) was assigned a HOMOGENEOUS AREA NUMBER (HAN). Homogeneous areas are materials of like composition, color (in some instances), texture and appearance. As an example, homogeneous area #102 is Drywall.

4. Methodology for Inspection (Continued)

Based on the homogeneous areas, samples of suspect materials were collected. Techniques used for sample collection were designed to minimize damage to suspected areas, reduce any potential for fiber release, and ensure the safety of the sampling team and building occupants. Samples were collected by Stohl Environmental using the following procedures:

- 1) The surface to be sampled was sprayed with amended water (detergent and water) as necessary
- 2) A plastic sample bag was held to the surface sampled
- 3) The sample was collected using tools appropriate to the friability of the material sampled
- 4) Sample bags were labeled with a unique sample identification number
- 5) Samples were recorded on a Chain of Custody form, and submitted under strict chain-of-custody procedures to an ELAP and NYSDOH approved and certified laboratory for analysis.

Samples were first analyzed using PLM, Polarized Light Microscopy in accordance with US Environmental Protection Agency Interim Method, 40 CFR Pt 763, Supt F, App A(7-1-87). For the sample results not considered definitive, additional analysis was performed under Transmission Electron Microscopy (TEM) in accordance with NYS DOH ELAP Item #198.4, for Non-friable Organically Bound Bulk Material (NOB). The results of this analysis confirmed whether or not a suspect material actually contained asbestos. The confirmed materials are listed in **SECTION 2 Executive Summary**.

5. Inspection Report

5.1 Homogeneous Area Numbers (HAN) and Sample Results

The following table summarizes the results of the inspection work performed at

Niagara University
822 Cleveland Avenue, Niagara Falls, New York

HAN	Description of Material and Location of Sample	Sample Number	PLM Result (Note 1)	TEM Result (Note 2)	Asbestos Yes/No
100B	1850's Plaster Skim Coat - Grey – Office 6	0410-822-100B-1	NAD	N/A	No
100B	1850's Plaster Skim Coat - Grey – Meeting Room	0410-822-100B-2	NAD	N/A	No
100B	1850's Plaster Skim Coat - Grey – Office 4	0410-822-100B-3	NAD	N/A	No
100B	1850's Plaster Skim Coat - Grey – Office 4	0410-822-100B-4	NAD	N/A	No
100B	1850's Plaster Skim Coat - Grey – Office 4	0410-822-100B-5	NAD	N/A	No
100C	1850'S Plaster Base Coat – Office 6	0410-822-100C-1	NAD	N/A	No
100C	1850'S Plaster Base Coat – Office 4	0410-822-100C-2	NAD	N/A	No
100C	1850'S Plaster Base Coat – Office 4	0410-822-100C-3	NAD	N/A	No
100C	1850'S Plaster Base Coat – Kitchen	0410-822-100C-4	NAD	N/A	No
100C	1850'S Plaster Base Coat – Meeting Room	0410-822-100C-5	NAD	N/A	No
101A	1900's Plaster Skim Coat - White - Stage	0410-822-101A-1	NAD	N/A	No
101A	1900's Plaster Skim Coat - White – Office 3	0410-822-101A-2	NAD	N/A	No
101A	1900's Plaster Skim Coat - White – Stage	0410-822-101A-3	NAD	N/A	No
101A	1900's Plaster Skim Coat - White – Open Sitting Area	0410-822-101A-4	NAD	N/A	No
101A	1900's Plaster Skim Coat - White – Office 2	0410-822-101A-5	NAD	N/A	No
101B	1900's Plaster Base Coat - Grey – Office 3	0410-822-101B-1	NAD	N/A	No
101B	1900's Plaster Base Coat - Grey – School Room	0410-822-101B-2	NAD	N/A	No
101B	1900's Plaster Base Coat - Grey – Wall Between Office 1 and Stage	0410-822-101B-3	NAD	N/A	No
101B	1900's Plaster Base Coat - Grey – Open Sitting Area	0410-822-101B-4	NAD	N/A	No
101B	1900's Plaster Base Coat - Grey – Office 2	0410-822-101B-5	NAD	N/A	No
102	Drywall – Open Sitting Area	0410-822-102-1	NAD	N/A	No
102	Drywall – Boiler	0410-822-102-2	NAD	N/A	No
102A	Joint Compound – Open Sitting Area	0410-822-102A-1	NAD	N/A	No
102A	Joint Compound – Boiler	0410-822-102A-2	NAD	N/A	No
103	Drywall Lathe – Wall Between Office 1 and Stage	0410-822-103-1	NAD	N/A	No
103	Drywall Lathe – Wall Between Office 1 and Stage	0410-822-103-2	NAD	N/A	No
200	1850's Plaster Skim Coat - White - Office 6	0410-822-200-1	NAD	N/A	No
200	1850's Plaster Skim Coat - White - Meeting Room	0410-822-200-2	NAD	N/A	No
200	1850's Plaster Skim Coat - White - Office 4	0410-822-200-3	NAD	N/A	No
200	1850's Plaster Skim Coat - White - Office 5	0410-822-200-4	NAD	N/A	No
200	1850's Plaster Skim Coat - White - School Room	0410-822-200-5	NAD	N/A	No

5.1 Homogeneous Area Numbers (HAN) and Sample Results

HAN	Description of Material and Location of Sample	Sample Number	PLM Result (Note 1)	TEM Result (Note 2)	Asbestos Yes/No
201	Textured Ceiling Materials – Meeting Room	0410-822-201-1	NAD	N/A	No
201	Textured Ceiling Materials – Meeting Room	0410-822-201-2	NAD	N/A	No
300	12"x12" Floor Tile - Red - Open Sitting Area	0410-822-300-1	4.3% Chrysotile	N/A	Yes
300	12"x12" Floor Tile - Red - Open Sitting Area	0410-822-300-2	NA/PS	N/A	Yes
300A	12"x12" Floor Tile Mastic - Yellow – Open Sitting Area	0410-822-300A-1	NAD	NAD	No
300A	12"x12" Floor Tile Mastic - Yellow – Open Sitting Area	0410-822-300A-2	NAD	NAD	No
301	12"x12" Floor Tile White w/ Streaks – Meeting Room	0410-822-301-1	NAD	NAD	No
301	12"x12" Floor Tile White w/ Streaks – Meeting Room	0410-822-301-2	NAD	NAD	No
301A	12"x12" Floor Tile Mastic – White – Meeting Room	0410-822-301A-1	NAD	NAD	No
301A	12"x12" Floor Tile Mastic – White – Meeting Room	0410-822-301A-2	NAD	NAD	No
302	Floor Tile Vapor Barrier - Meeting Room	0410-822-302-1	NAD	NAD	No
302	Floor Tile Vapor Barrier - Meeting Room	0410-822-302-2	NAD	NAD	No
303	12"x12" Floor Tile - Yellow - Kitchen	0410-822-303-1	Trace	1.6% Chrysotile	Yes
303	12"x12" Floor Tile - Yellow - Kitchen	0410-822-303-2	Trace	N/A	Yes
303A	12"x12" Yellow Floor Tile Mastic - Yellow – Kitchen	0410-822-303A-1	NAD	NAD	No
303A	12"x12" Yellow Floor Tile Mastic - Yellow – Kitchen	0410-822-303A-2	NAD	NAD	No
304	12"x12" Floor Tile - Beige w/ Streaks - Office 6	0410-822-304-1	NAD	NAD	No
304	12"x12" Floor Tile - Beige w/ Streaks - Office 6	0410-822-304-2	NAD	NAD	No
304A	12"x12" Floor Tile Mastic - Black – Office 6	0410-822-304A-1	NAD	NAD	No
304A	12"x12" Floor Tile Mastic - Black – Office 6	0410-822-304A-2	NAD	NAD	No
305	Linoleum Green Square Pattern – Bathroom 1	0410-822-305-1	4.3% Chrysotile	N/A	Yes
305	Linoleum Green Square Pattern – Bathroom 1	0410-822-305-2	NA/PS	N/A	Yes
306	Linoleum Flower Pattern Square - Bathroom 2	0410-822-306-1	NAD	NAD	No
306	Linoleum Flower Pattern Square - Bathroom 2	0410-822-306-2	NAD	NAD	No
307	Linoleum Mastic - Yellow - Bathroom 1	0410-822-307-1	12.9% Chrysotile	N/A	Yes
307	Linoleum Mastic - Yellow - Bathroom 2	0410-822-307-2	NA/PS	N/A	Yes
309	Linoleum Star Pattern – School Room	0410-822-309-1	N/A	N/A	No
309	Linoleum Star Pattern – School Room	0410-822-309-2	N/A	N/A	No
310	Linoleum Brick Pattern – Stairs By Boiler	0410-822-310-1	N/A	N/A	No
310	Linoleum Brick Pattern – Stairs By Boiler	0410-822-310-2	N/A	N/A	No

5.1 Homogeneous Area Numbers (HAN) and Sample Results

HAN	Description of Material and Location of Sample	Sample Number	PLM Result (Note 1)	TEM Result (Note 2)	Asbestos Yes/No
311	Linoleum Mastic - Brown - School Room	0410-822-311-1	N/A	N/A	No
311	Linoleum Mastic - Brown - School Room	0410-822-311-2	N/A	N/A	No
400	Mud Elbow - Boiler	0410-822-400-1	26.7% Chrysotile	N/A	Yes
400	Mud Elbow - Meeting Room	0410-822-400-2	NA/PS	N/A	Yes
400	Mud Elbow - Kitchen	0410-822-400-3	NA/PS	N/A	Yes
401	Air Cell Pipe Insulation – Boiler	0410-822-401-1	66.7% Chrysotile	N/A	Yes
401	Air Cell Pipe Insulation – Meeting Room	0410-822-401-2	NA/PS	N/A	Yes
401	Air Cell Pipe Insulation – Kitchen	0410-822-401-3	NA/PS	N/A	Yes
402	Magnesia Pipe Insulation – Boiler Room	0410-822-402-1	6.1% Crocidolite 6.1% Chrysotile	N/A	Yes
402	Magnesia Pipe Insulation – Boiler Room	0410-822-402-2	NA/PS	N/A	Yes
402	Magnesia Pipe Insulation – Boiler Room	0410-822-402-3	NA/PS	N/A	Yes
600	Sink Insulation	Note 3	Note 3	Note 3	Yes
601	Electrical Panel Heat Shield	Note 3	Note 3	Note 3	Yes
602	Fire Door Insulation	Note 3	Note 3	Note 3	Yes
603	1850's Window Caulk – Exterior	0410-822-603-1	2.1% Chrysotile	N/A	Yes
603	1850's Window Caulk – Exterior	0410-822-603-2	NA/PS	N/A	Yes
604	1850's Window Glazing – Exterior	0410-822-604-1	Trace	1.8% Anthophyllite	Yes
604	1850's Window Glazing – Exterior	0410-822-604-2	Trace	NA/PS	Yes
605	Addition Window Caulk – Exterior	0410-822-605-1	NAD	NAD	No
605	Addition Window Caulk – Exterior	0410-822-605-2	NAD	NAD	No
606	Addition Window Glazing – Exterior	0410-822-606-1	Trace	Trace	No
606	Addition Window Glazing – Exterior	0410-822-606-2	Trace	Trace	No
700	Field Felt – Addition Flat Roof	0410-822-700-1	5.3% Chrysotile	N/A	Yes
700	Field Felt – Addition Flat Roof	0410-822-700-2	NA/PS	N/A	Yes
701	Flashing Felt – Addition Flat Roof	0410-822-701-1	4.3% Chrysotile	N/A	Yes
701	Flashing Felt – Addition Flat Roof	0410-822-701-2	NA/PS	N/A	Yes
703	Roof Deck – Addition Flat Roof	0410-822-703-1	NAD	NAD	No
703	Roof Deck – Addition Flat Roof	0410-822-703-2	NAD	NAD	No
705	Repair Tar – Addition Flat Roof	0410-822-705-1	4.6% Chrysotile	N/A	Yes
706	Hot Mop– Addition Flat Roof	0410-822-706-1	NAD	NAD	No
706	Hot Mop– Addition Flat Roof	0410-822-706-2	NAD	NAD	No
707	Roof Caulk – Addition Flat Roof	0410-822-707-1	NAD	NAD	No
707	Roof Caulk – Addition Flat Roof	0410-822-707-2	NAD	NAD	No

SEE NOTES ON THE FOLLOWING PAGE

5.1 Homogeneous Area Numbers (HAN) and Sample Results

Notes to Inspection Table 5.1:

- Note 1:** PLM= Analysis by Polarized Light Microscopy
- Note 2:** TEM = Transmission Electron Microscopy. NYSDOH requires Non-friable Organically Bound (NOB) bulk materials be additionally analyzed by TEM if negative under PLM.
- Note 3:** This material was assumed to contain asbestos to either save the client on lab fees or because the material was adhered to another asbestos containing material (or adjacent to other materials needing abatement) and must be managed as such.
- NAD** = No Asbestos Detected
- N/A** = Not Applicable
- NA/PS** = Not Analyzed / Positive Stop
- Trace** = Less than 1% asbestos, material considered non-ACM

Section 2.0 Lead-Based Paint Inspection

2.1 Introduction

Stohl Environmental, LLC was retained by the Niagara University to inspect the structure located at 822 Cleveland Avenue in Niagara Falls, New York for the presence of surfaces containing lead-based paint (LBP) in areas of planned renovations including:

- The Original 1850's basement and exterior windows
- The 1900's Additions in the basement, Sunday school room and exterior windows

Stohl Environmental was charged with:

1. locating suspect surfaces,
2. measuring lead concentrations on suspect surfaces using an X-ray florescence spectrum analyzer, and
3. bulk sampling for lab analysis where necessary.

Although this report is a comprehensive analysis of the lead-based paint in this structure, the following information, as well as a reading of the sources listed at the end of this section, will help ensure compliance to applicable rules, laws and regulations regarding lead based paint.

TITLE X:

On October 28, 1995, the Housing and Community Development Act of 1992 was signed into law. Title X, as this bill is commonly referred to, is comprehensive and significant in addressing lead poisoning and prevention. Under the Toxic Substances Control Act (TSCA), as amended by Title X, EPA is developing regulations governing lead-based paint hazard evaluation and abatement in private and public housing, public and commercial buildings and commercial structures. When the changes brought about by this legislation are fully defined and enacted, virtually all parties involved in ownership, rental, management, financing/lending, contracting/abatement, and insurance will be affected.

2.1 Introduction (Continued)

Although it is recommended that property owners, lenders, insurers, etc. become familiar with the full content of Title X and the EPA regulations, an understanding of the following terms will assist in the interpretation of the results of this survey:

1. The term “lead-based paint” as used in Title X is defined as paint on surfaces with lead in excess of 1.0 mg/cm² (milligrams per centimeter squared) as measured by X-ray fluorescence (XRF) detector or 0.5 percent by weight.
2. The term “lead based paint hazard” is defined as any condition that causes exposure to lead sufficient to cause adverse human effects.
3. “Deteriorated LBP” is any interior or exterior LBP that is peeling, chipping, chalking, or cracking, or located on a surface or fixture that is damaged or deteriorated.
4. LBP on any “friction surface” is defined as any interior or exterior surface subject to damage by repeated impacts, such as painted floors and friction surfaces on windows.
5. LBP on any “impact surface” is defined as any interior or exterior surface subject to damage by repeated impacts, such as parts of door frames.
6. LBP on any “accessible surface” is defined as any interior or exterior surface accessible for a young child to mouth or chew, such as a window sill.
7. “Lead-contaminated dust” is defined as a surface dust in residential dwellings that contains an area or mass concentration of lead in excess of the standard to be established by EPA.

2.1 Introduction (Continued)

OSHA

On May 4, 1993, OSHA promulgated the Lead Exposure in Construction Rule (29 CFR Part 1926.62). This regulation applies to all construction activities involving potential lead exposures. This regulation defines construction work as "...work for construction, alteration and/or repair including painting and decorating" and further states "...the standard for the construction industry applies to all occupational exposure to lead in all construction work in which lead, in any amount, is present in an occupationally related context ... where the source of the lead is employment related..."

The employer must ensure that no worker is exposed to concentrations of lead in excess of the permissible exposure limit (PEL) for lead, which is an eight hour time weighted average (TWA) exposure of 50 mg/m³ (micrograms per cubic meter). This means that the pre-project site must be inspected to determine if a lead hazard exists. If determined to exist, the employer must either perform an "Exposure Assessment" as defined in 29 CFR Part 1926.62 paragraph (d), or implement employee protective measures as prescribed in paragraph (d)(2)(v) including appropriate respiratory protection, personal protective clothing, change areas, hand washing facilities, biological monitoring, and training.

HUD

The statutory requirements and foundations for HUD Guidelines can be found in Section 302 of the Lead-Based Paint Poisoning Prevention Act (LBPPPA).

Certain aspects of the HUD Guidelines are typically applied to public and commercial buildings. The most common adopted techniques used to identify LBP are X-ray Fluorescence Spectrum Analyzer (XRF) and Atomic Absorption Spectroscopy (AAS). HUD defines LBP as having an XRF reading greater than 1.0 mg of lead per centimeter squared, or a paint chip analyzed by AAS having greater than 0.5 percent lead by weight.

The above information coupled with this report will help assure compliance to applicable laws and regulations and protect the occupants and contractors from exposure while in the building.

2.2 Methodology

Stohl Environmental used a pb2001 Heuresis to test suspect painted surfaces on the exterior and interior. Progression through the exterior and interior followed a clockwise direction around the floor plan. Each component tested is identified by its particular side of the building, labeled walls "A, B, C, or D". Side A of any room is always the same side as the front exterior entrance (or address side of the building). Side B is the side to the left of side A, and so on.

Representative surfaces/components were tested in a manner designed to adequately represent the different components, substrates, types of paint, construction and paint history throughout the building. Surfaces tested included interior walls, doors, structural members, windows and painted exterior components.

2.3 Inspection Report

During the lead-based paint inspection conducted on April 10, 2020 both the interior and exterior painted components of the site were inspected. Painted components were identified and tested based on component groups and paint history.

The XRF analysis indicated that the following painted surfaces have a lead content at greater than the Title X threshold (greater than 1.0 mg/cm²) for classification as lead-based paint. For any renovations undertaken that require demolition of these painted surfaces, contractors should be advised of the presence of lead, and required to comply with the aforementioned OSHA regulations for construction worker safety.

Component groups that were identified to contain LBP are:

- **White Interior/Exterior Window Components**
- **White Metal Radiators**
- **White and Varnish Coated Wood Wainscoting**
- **Yellow, Green, White Plaster Walls/Ceilings**
- **Brown Metal Columns**
- **Varnish Coating Columns**
- **Door Casings**
- **Yellow Block Walls**
- **Varnish Coated Wood Door and Door Components**

(SEE THE TABLE IN SECTION 2.4 FOR XRF ANALYSIS OF INDIVIDUAL COMPONENTS/SUBSTRATES)

2.4 XRF Spectrum Analyzer Report

Reading No	Side	Room	Component	Substrate	Color	Results	XRF Reading
1		Calibration					0.9
2		Calibration					1
3		Calibration					1.1
4	A	Main Congregation Room	Wall	Plaster	White	Positive	13.7
5	C	Main Congregation Room	Wall	Plaster	White	Positive	10.9
6	D	Main Congregation Room	Wainscoting	Wood	White	Positive	7.9
7	B	Main Congregation Room	Wainscoting	Wood	White	Positive	9.5
8	B	Main Congregation Room	Radiator	Metal	White	Negative	0.1
9	B	Main Congregation Room	Radiator	Metal	White	Negative	0.2
10	D	Main Congregation Room	Radiator	Metal	White	Positive	1.1
11	D	Main Congregation Room	Window Casing	Wood	White	Positive	18.5
12	D	Main Congregation Room	Window Sill	Wood	White	Positive	16.6
13	A	Main Congregation Room	Column	Metal	Brown	Positive	6.3
14	A	Main Congregation Room	Door	Wood	Varnish	Negative	-0.1
15	A	Main Congregation Room	Door	Wood	Varnish	Negative	-0.1
16	A	Main Congregation Room	Door Casing	Wood	Varnish	Negative	0.1
17	A	Main Congregation Room	Door Casing	Wood	Varnish	Negative	0.1
18	D	Main Congregation Room	Wall	Block	Yellow	Positive	10.7
19	D	Main Congregation Room	Wainscoting	Wood	Varnish	Positive	4.5
20	A	Vestibule	Column	Wood	Varnish	Positive	2.9
21	A	Vestibule	Door	Wood	Varnish	Negative	-0.1
22	A	Vestibule	Door Casing	Wood	Varnish	Positive	9
23	A	Main Congregation Room	Floor	Wood	Varnish	Negative	-0.1
24	0	Main Congregation Room	church pews	Wood	Varnish	Negative	-0.3
25	0	Main Congregation Room	church pews	Wood	Varnish	Negative	-0.1
26	A	Hallway	Wall	Plaster	White	Negative	-0.2
27	B	Hallway	Wall	Plaster	White	Negative	0.6
28	B	Hallway	Wall	Plaster	White	Negative	0.2
29	B	Office	Wall	Plaster	Green	Negative	-0.3
30	D	Office	Wall	Plaster	Green	Negative	-0.2
31	A	Office	Radiator	Metal	Silver	Negative	0
32	A	Office	Radiator	Metal	Silver	Negative	0.1
33	A	Office	Window Casing	Wood	Varnish	Negative	0
34	A	Office	Window Casing	Wood	Varnish	Negative	0.1

2.4 XRF Spectrum Analyzer Report

Reading No	Side	Room	Component	Substrate	Color	Results	XRF Reading
35	A	Office	Window Trough	Wood	Varnish	Negative	-0.1
36	A	Office	Door Casing	Wood	Varnish	Negative	0
37	A	Office	Door Casing	Wood	Varnish	Negative	0
38	A	Office	Door Jamb	Wood	Varnish	Negative	-0.1
39	A	Office	Door Stop	Wood	Varnish	Negative	0.1
40	D	Mens Room	Door Stop	Wood	Varnish	Negative	0.1
41	D	Mens Room	Door Jamb	Wood	Varnish	Negative	-0.1
42	D	Mens Room	Door Casing	Wood	Varnish	Negative	-0.2
43	A	Mens Room	Wall	Plaster	Pink	Negative	0.1
44	C	Mens Room	Wall	Plaster	Pink	Negative	0.3
45	C	Mens Room	Wall	Plaster	White	Negative	-0.4
46	B	Mens Room	Wall	Plaster	White	Negative	-0.3
47	B	Mens Room	Window Casing	Wood	Varnish	Negative	-0.1
48	B	Mens Room	Window Sill	Wood	Varnish	Negative	0
49	0	Mens Room	Floor	Concrete	Gray	Negative	0
50	A	Womens Room	Wall	Plaster	Purple	Negative	0.3
51	C	Womens Room	Wall	Plaster	Purple	Negative	0.1
52	C	Womens Room	Wall	Plaster	White	Negative	0.1
53	A	Womens Room	Wall	Plaster	White	Negative	0.1
54	C	Womens Room	Radiator	Metal	Purple	Negative	0
55	C	Conference Room	Radiator	Metal	White	Negative	0.4
56	C	Conference Room	Radiator	Metal	White	Negative	0.3
57	C	Conference Room	Wall	Plaster	White	Positive	1
58	C	Conference Room	Wall	Plaster	Blue	Negative	0.6
59	C	Conference Room	Wall	Plaster	Blue	Negative	0.3
60	A	Conference Room	Wall	Plaster	Blue	Negative	0.1
61	A	Conference Room	Chair Rail	Wood	Varnish	Negative	0
62	B	Conference Room	Chair Rail	Wood	Varnish	Negative	-0.1
63	B	Conference Room	Window Sill	Wood	Varnish	Negative	0.1
64	B	Conference Room	Window Sill	Wood	Varnish	Negative	0.1
65	C	Conference Room	Door Casing	Wood	Varnish	Negative	-0.1
66	C	Conference Room	Door Casing	Wood	Varnish	Negative	-0.1
67	C	Conference Room	Door	Wood	Varnish	Negative	0
68	C	Conference Room	Baseboard	Wood	Varnish	Negative	-0.1

2.4 XRF Spectrum Analyzer Report

Reading No	Side	Room	Component	Substrate	Color	Results	XRF Reading
69	0	Conference Room	Floor	Wood	Varnish	Negative	0
70	A	Sitting Room	Wall	Plaster	Green	Negative	0.5
71	B	Sitting Room	Wall	Plaster	Green	Negative	0.7
72	B	Sitting Room	Wall	Plaster	Green	Negative	0.7
73	B	Sitting Room	Wall	Plaster	Green	Negative	0
74	C	Classroom	Wall	Plaster	Green	Positive	1.5
75	C	Classroom	Radiator	Metal	Green	Negative	0.3
76	C	Classroom	Radiator	Metal	Green	Negative	0.4
77	C	Classroom	Radiator	Metal	Green	Negative	0.5
78	D	Music Office	Radiator	Metal	White	Negative	0.2
79	D	Music Office	Window Sill	Wood	Varnish	Negative	0.1
80	D	Music Office	Window Sash	Wood	Varnish	Negative	-0.1
81	D	Music Office	Window Casing	Wood	Varnish	Negative	0
82	C	Music Office	Wall	Plaster	Beige	Negative	0.2
83	A	Music Office	Wall	Plaster	Beige	Negative	-0.1
84	C	Hallway	Door Jamb	Wood	White	Negative	0.2
85	C	Hallway	Door Jamb	Wood	White	Negative	0.2
86	0	Main Congregation Room	Ceiling	Plaster	White	Positive	2.9
87	A	Main Congregation Room	Stair Stringer	Wood	Varnish	Negative	0
88	A	Main Congregation Room	Stair Tread	Wood	Varnish	Negative	0
89	A	Main Congregation Room	Stair Riser	Wood	Varnish	Negative	0.1
90	A	Main Congregation Room	Railing	Wood	Varnish	Negative	0
91	B	Basement Meeting Room	Wall	Plaster	White	Negative	0.8
92	B	Basement Meeting Room	Wall	Plaster	White	Negative	0.7
93	B	Basement Meeting Room	Wall	Plaster	White	Negative	0.3
94	B	Basement Meeting Room	Wall	Plaster	White	Negative	0.8
95	B	Basement Meeting Room	Wall	Plaster	White	Negative	-0.1
96	B	Basement Meeting Room	Radiator	Metal	White	Positive	1
97	B	Basement Meeting Room	Window Sill	Wood	White	Positive	3
98	B	Basement Meeting Room	Window Sash	Wood	Brown	Negative	0.1
99	B	Basement Meeting Room	Wainscoting	Wood	Varnish	Positive	4.6
100	A	Basement Meeting Room	Wainscoting	Wood	Purple	Positive	4.8
101	A	Basement Meeting Room	Wall	Plaster	White	Positive	2.1
102	C	Basement Meeting Room	Door Casing	Wood	Purple	Negative	0.2

2.4 XRF Spectrum Analyzer Report

Reading No	Side	Room	Component	Substrate	Color	Results	XRF Reading
103	C	Basement Meeting Room	Door Jamb	Wood	Purple	Negative	0.2
104	C	Basement Meeting Room	Door	Wood	Purple	Negative	0
105	C	Basement Meeting Room	Wall	Plaster	Yellow	Positive	1.8
106	C	Basement Stage	Wall	Plaster	White	Negative	0.1
107	C	Basement Stage	Wall	Plaster	White	Negative	0
108	A	Basement Stage	Wainscoting	Wood	Varnish	Negative	-0.1
109	A	Basement Stage	Wall	Plaster	Yellow	Negative	0.3
110	A	Basement Stage	Wall	Plaster	White	Negative	0.3
111	A	Basement Stage	Radiator	Metal	Silver	Negative	0.3
112	A	Boiler Room	Door Casing	Wood	White	Positive	5.7
113	B	Boiler Room	Wall	Brick	White	Negative	-0.1
114	B	Boiler Room	Wall	Brick	White	Negative	-0.3
115	B	Boiler Room	Door Casing	Wood	White	Negative	-0.1
116	B	Basement Meeting Room	Pipe	Fiberglass	White	Negative	-0.1
117	B	Basement Meeting Room	Pipe	aircell	White	Negative	0.1
118	-	Basement Meeting Room	Ceiling	Plaster	White	Negative	0.2
119	-	Basement Meeting Room	Ceiling	Plaster	White	Negative	0.2
120	-	Basement Meeting Room	Pipe	Metal	White	Negative	0
121		Calibration					1
122		Calibration					1.1
123		Calibration					1

Section 3.0 PCBs in Caulk Sampling

3.1 Introduction

Stohl Environmental, LLC was retained by the Niagara University to inspect the structure located at 822 Cleveland Avenue in Niagara Falls, New York for the presence of caulking/sealant materials suspected of containing Polychlorinated Biphenyls (PCBs) in areas of planned renovations including:

- The Original 1850's basement and exterior windows
- The 1900's Additions in the basement, Sunday school room and exterior windows

Stohl Environmental was charged with:

1. locating suspect materials,
2. bulk sampling of caulking/sealants for lab analysis to determine PCB content.
3. submission of samples to and independent certified laboratory, and preparation of a summary report

3.2 Background

PCBs are mixtures of synthetic organic chemicals with the same basic chemical structure and similar physical properties ranging from oily liquids to waxy solids. Due to their non-flammability, chemical stability, high boiling point and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, rubber and caulking products; in pigments, dyes and carbonless copy paper and many other applications. More than 1.5 billion pounds of PCBs were manufactured in the United States prior to cessation of production in 1977.

Concern over the toxicity and persistence in the environment of Polychlorinated Biphenyls (PCBs) led Congress in 1976 to enact 6(e) of the Toxic Substances Control Act (TSCA) that included among other things, prohibitions on the manufacture, processing, and distribution in commerce of PCBs.

The following is a partial listing of applicable regulations regarding proper handling and disposal:

- * New York State Department of Environmental Conservation - 6 NYCRR Part 371
- * USEPA 40 CFR Part 761.62 Disposal of PCB Bulk Product Waste

3.3 Methodology

Stohl Environmental collected samples of at least 10g of Caulk/Sealant. Samples were recorded and handled according to strict chain-of-custody protocol sample sizes and submitted to an independent certified laboratory for analysis by EPA Method 8082.

All solid wastes containing 50 parts per million (ppm) by weight (on a dry weight basis for other than liquid wastes) or greater of polychlorinated biphenyls (PCBs) are listed hazardous wastes, excluding small capacitors as defined in paragraph (3) of NYCRR Part 371 and PCB Articles drained in accordance with subparagraphs (2)(ii) and (iii) of Part 371 Section (e). PCB Articles that contain less than 50 ppm PCBs are not regulated as hazardous waste.

3.4 Inspection Report

During the PCB Caulk sampling conducted on March 31, 2020, 3 samples were collected for analysis.

The laboratory analysis performed on caulk/sealant samples revealed the following:

- **All Samples Collected were analyzed and found to be below the 50 PPM threshold for PCB's**

(SEE THE TABLE IN SECTION 3.5 FOR ANALYSIS RESULTS OF THE INDIVIDUAL PCB COMPOUNDS/PARAMETERS IN THE SAMPLES.

3.5 PCB Analysis Report

822 Cleveland Avenue, Niagara Falls

0410-822-603-P

Sample #	Parameter/ PCB Compound	Analysis Method	Results (µg/kg) ppb	Results reported in ppm	Hazardous Waste (Y/N)
0410-822-605-P	PCB-1016	EPA 8082	<494	<.49	N
	PCB-1221	EPA 8082	<494	<.49	N
	PCB-1232	EPA 8082	<494	<.49	N
	PCB-1242	EPA 8082	<494	<.49	N
	PCB-1248	EPA 8082	<494	<.49	N
	PCB-1254	EPA 8082	<494	<.49	N
	PCB-1260	EPA 8082	<494	<.49	N
	PCB 1262	EPA 8082	<494	<.49	N
	PCB-1268	EPA 8082	<494	<.49	N
TOTAL					N

0410-822-605-P

Sample #	Parameter/ PCB Compound	Analysis Method	Results (µg/kg) ppb	Results reported in ppm	Hazardous Waste (Y/N)
0410-822-605-P	PCB-1016	EPA 8082	<497	<.49	N
	PCB-1221	EPA 8082	<497	<.49	N
	PCB-1232	EPA 8082	<497	<.49	N
	PCB-1242	EPA 8082	<497	<.49	N
	PCB-1248	EPA 8082	<497	<.49	N
	PCB-1254	EPA 8082	<497	<.49	N
	PCB-1260	EPA 8082	<497	<.49	N
	PCB 1262	EPA 8082	<497	<.49	N
	PCB-1268	EPA 8082	<497	<.49	N
TOTAL					N

0410-822-707-P

Sample #	Parameter/ PCB Compound	Analysis Method	Results (µg/kg) ppb	Results reported in ppm	Hazardous Waste (Y/N)
0410-822-707-P	PCB-1016	EPA 8082	<483	<.48	N
	PCB-1221	EPA 8082	<483	<.48	N
	PCB-1232	EPA 8082	<483	<.48	N
	PCB-1242	EPA 8082	<483	<.48	N
	PCB-1248	EPA 8082	<483	<.48	N
	PCB-1254	EPA 8082	628	.628	N
	PCB-1260	EPA 8082	<483	<.48	N
	PCB 1262	EPA 8082	<483	<.48	N
	PCB-1268	EPA 8082	<483	<.48	N
TOTAL					N

Appendix A Floor Plans

Niagara University

Pre-Renolition Asbestos Inspection
 822 Cleveland Avenue
 Niagara Falls, New York
 Conditions as of April 14, 2020

Stohl Env. File #2020-279

Asbestos Containing Materials

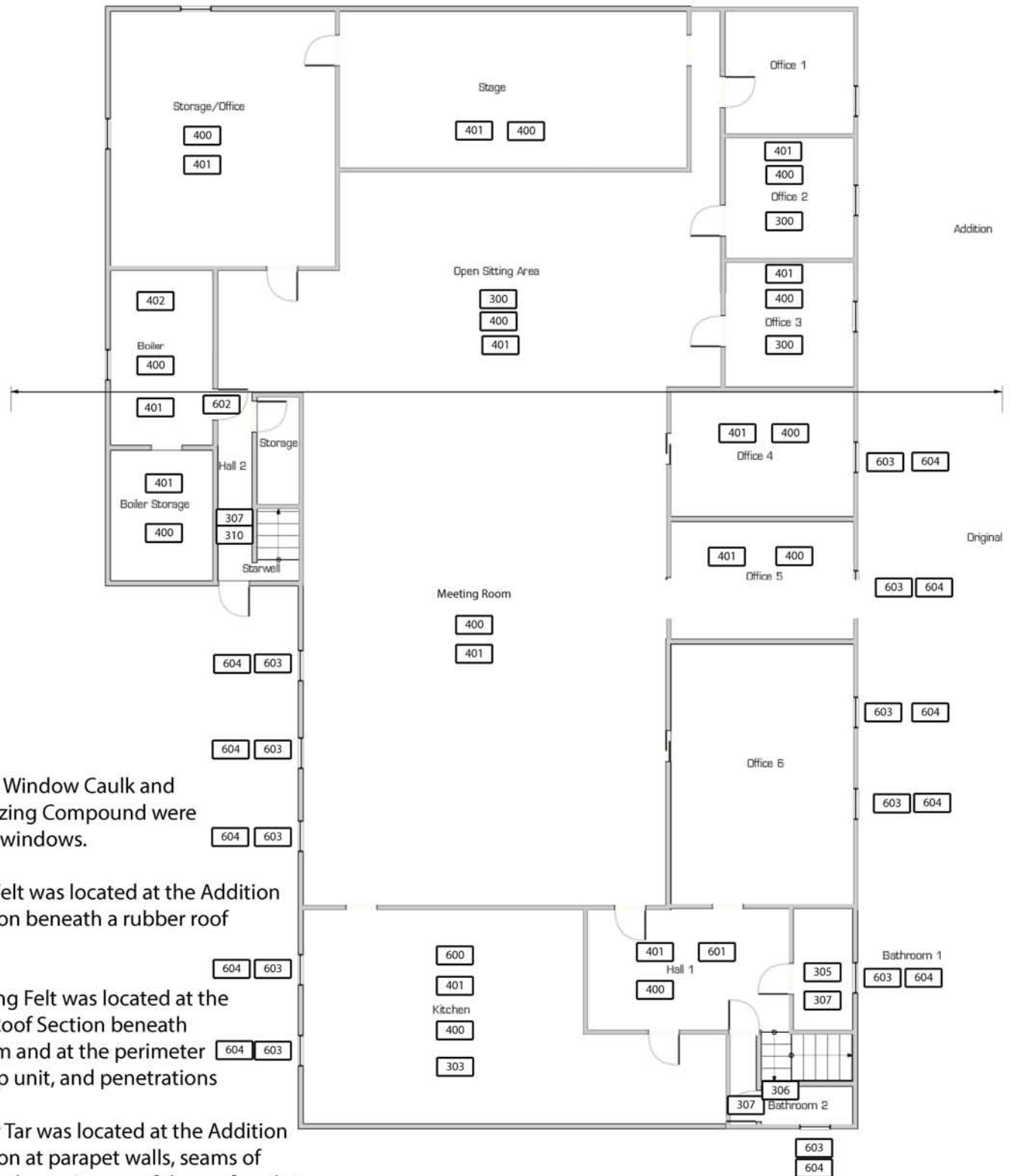
HAN	Description	Approx. Qty.
300	12"x12" Floor Tile - Red	900 sqft
303	12"x12" Floor Tile - Yellow	415 sqft
305	Linoleum Green Square Pattern	Included in HAN 307
306	Linoleum- Flower Pattern Square	Included in HAN 307
307	Linoleum Mastic - Yellow	305 sqft
310	Linoleum- Brick Pattern	Included in HAN 307
400	Mudded Pipe Elbow Insulation	75 sqft
401	Air Cell Pipe Insulation	250 lf
402	Magnesia Pipe Insulation	25lf
600	Sink Insulation	<10 sqft
601	Electrical Panel Heat Shield	<10 sqft
602	Fire Door Insulation	1 Door
603	1850's Window Caulk	<10 sqft
604	1850's Window Glazing Compound	<10sqft
700	Field Felt	2,700 sq ft
701	Flashing Felt	Included in HAN 700
705	Repair Tar	<10 sq ft

Note: HAN 603 1850's Window Caulk and HAN 604 Window Glazing Compound were located at all exterior windows.

Note: HAN 700 Field Felt was located at the Addition on the Flat Roof Section beneath a rubber roof system.

Note: HAN 701 Flashing Felt was located at the Addition on the Flat Roof Section beneath the rubber roof system and at the perimeter of the roof, at roof top unit, and penetrations

Note: HAN 705 Repair Tar was located at the Addition on the Flat Roof Section at parapet walls, seams of metal end caps, along the perimeter of the roof, and at repairs, penetrations, and roof top units.



Appendix B Site Photos



Asbestos Material In Photo

HAN 300 – 12” x 12” Floor Tile - Red

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 303 – 12” x 12” Floor Tile – Yellow

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 305 – Linoleum Green Square Pattern

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

Appendix B Site Photos



Asbestos Material In Photo

HAN 307 – Linoleum Mastic – Yellow

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 400 – Mudded Pipe Elbow Insulation

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

Appendix B Site Photos



Asbestos Material In Photo

HAN 401 – Air Cell Pipe Insulation

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 402 – Magnesia Pipe Insulation

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

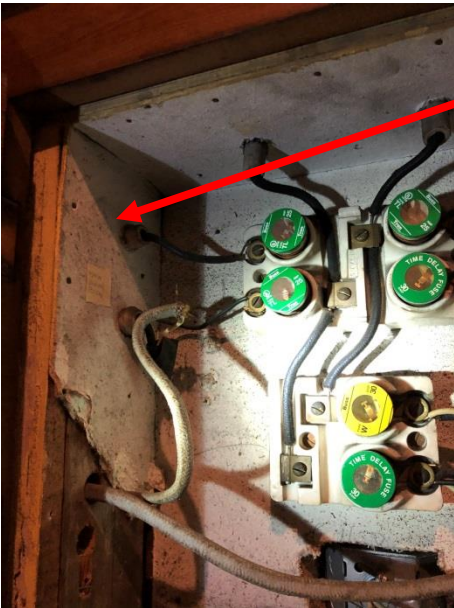
Appendix B Site Photos



Asbestos Material In Photo

HAN 600 – Sink Insulation

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 601 – Electrical Panel

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

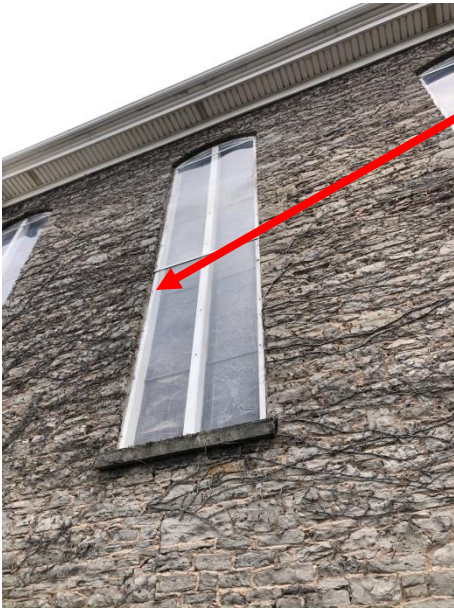
Appendix B Site Photos



Asbestos Material In Photo

HAN 602 – Fire Door Insulation

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 603/604 – Window Glazing and Window Caulk

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

Appendix B Site Photos



Asbestos Material In Photo

HAN 603 – 1850's Window Caulk

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 604– 1850's Window Glazing

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

Appendix B Site Photos



Asbestos Material In Photo

HAN 700 – Field Felt

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 701 – Flashing Felt

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

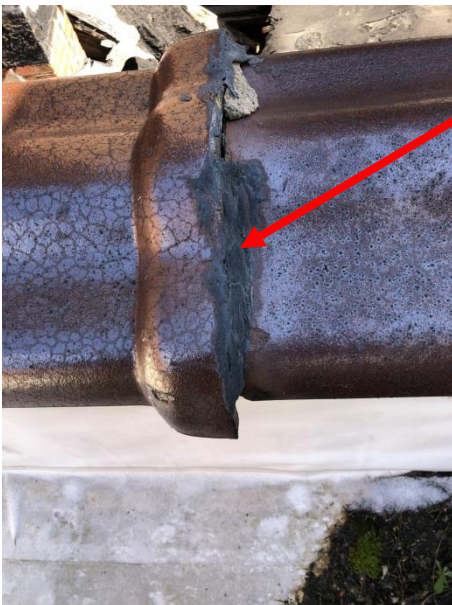
Appendix B Site Photos



Asbestos Material In Photo

HAN 701 – Flashing Felt

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)



Asbestos Material In Photo

HAN 705 – Repair Tar

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

Appendix B Site Photos



Asbestos Material In Photo

HAN 705 – Repair Tar

See Section 1.2 & Appendix A Floor Plans for approximate quantities and location(s) of asbestos containing material(s)

Appendix B Site Photos



Typical Wainscoting and Radiator covered in lead based paint on the date of the inspection

Appendix B Site Photos



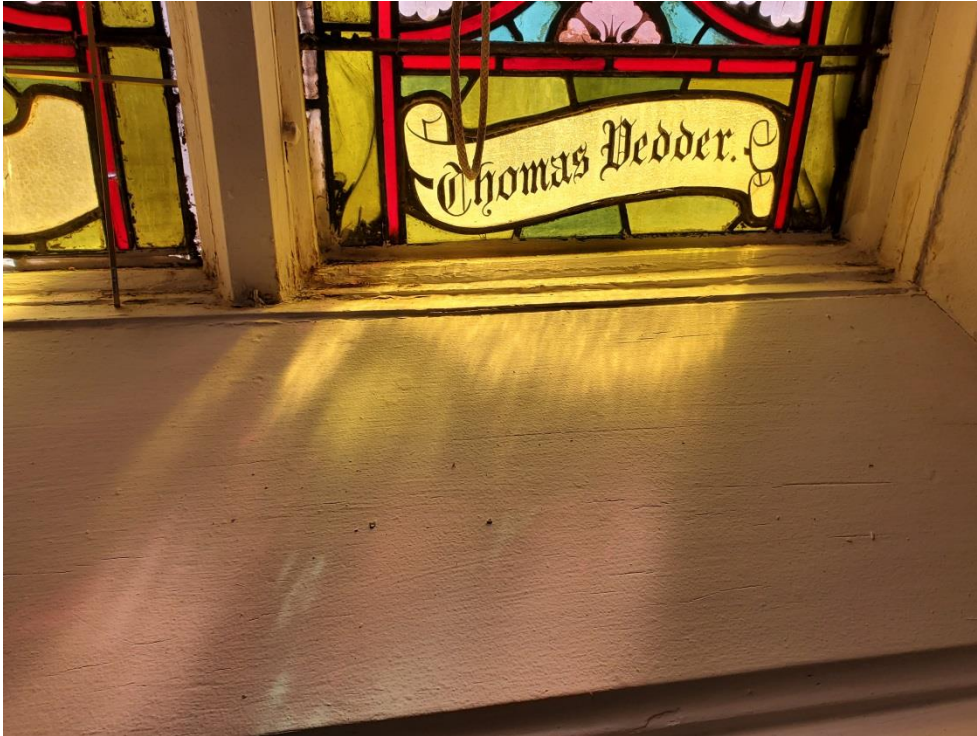
Typical Radiator covered in lead based paint on the date of the inspection

Appendix B Site Photos



Typical Vanish Wainscoting covered in lead based paint on the date of the inspection

Appendix B Site Photos



Typical Window Sill covered in lead based paint on the date of the inspection

Appendix B Site Photos



Typical Window Components covered in lead based paint on the date of the inspection

Appendix B Site Photos



Typical Walls covered in lead based paint on the date of the inspection

Appendix B Site Photos



Typical Door Components covered in lead based paint on the date of the inspection

Appendix C Laboratory Report and Chain of Custody

**Laboratory Reports
Chain of Custody Documents**



AmeriSci New York

117 EAST 30TH ST.

NEW YORK, NY 10016

TEL: (212) 679-8600 • FAX: (212) 679-3114

PLM Bulk Asbestos Report

Stohl Environmental, LLC.
Attn: Tony Franjoine
3860 California Rd.

Orchard Park, NY 14127

Date Received 04/15/20 **AmeriSci Job #** 220041749
Date Examined 04/15/20 **P.O. #**
ELAP # 11480 **Page** 1 of 16
RE: 2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-100B-1 100B Location: Office 6 - 1850's Plaster (Skim Coat / Gray)	220041749-01	No	NAD ¹ (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-100B-2 100B Location: Meeting Room - 1850's Plaster (Skim Coat / Gray)	220041749-02	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-100B-3 100B Location: Office 4 - 1850's Plaster (Skim Coat / Gray)	220041749-03	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-100B-4 100B Location: Office 4 - 1850's Plaster (Skim Coat / Gray)	220041749-04	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-100B-5 100B Location: Office 4 - 1850's Plaster (Skim Coat / Gray)	220041749-05	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-100C-1 100C Location: Office 6 - 1850's Plaster (Base Coat)	220041749-06	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-100C-2 100C Location: Office 4 - 1850's Plaster (Base Coat)	220041749-07	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-100C-3 100C Location: Office 4 - 1850's Plaster (Base Coat)	220041749-08	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-100C-4 100C Location: Kitchen - 1850's Plaster (Base Coat)	220041749-09	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-100C-5 100C Location: Meeting Room - 1850's Plaster (Base Coat)	220041749-10	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-101A-1 101A Location: Stage - 1900's Plaster (Skim Coat / White)	220041749-11	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-101A-2 101A	220041749-12 Location: Office 3 - 1900's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: OffWhite, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-101A-3 101A	220041749-13 Location: Stage - 1900's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-101A-4 101A	220041749-14 Location: Open Sitting Area - 1900's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-101A-5 101A	220041749-15 Location: Office 2 - 1900's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-101B-1 101B	220041749-16 Location: Office 3 - 1900's Plaster (Base Coat / Gray)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-101B-2 101B	220041749-17 Location: School Room - 1900's Plaster (Base Coat / Gray)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-101B-3 101B	220041749-18 Location: Hall Between Office 6 And Stage - 1900's Plaster (Base Coat / Gray)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-101B-4 101B	220041749-19 Location: Open Sitting Area - 1900's Plaster (Base Coat / Gray)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-101B-5 101B	220041749-20 Location: Office 2 - 1900's Plaster (Base Coat / Gray)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Cementitious, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-102-1 102	220041749-21 Location: Open Sitting Area - Drywall	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey/Brown, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose 10 %, Non-fibrous 90 %			
0410-822-102-2 102	220041749-22 Location: Boiler - Drywall	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey/Brown, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose 15 %, Non-fibrous 85 %			
0410-822-102A-1 102A	220041749-23 Location: Open Sitting Area - Joint Compound	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-102A-2 102A	220041749-24 Location: Boiler - Joint Compound	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-103-1 103	220041749-25 Location: Hall Between Office 6 And Stage - Drywall Lathe	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey/Brown, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose 5 %, Non-fibrous 95 %			
0410-822-103-2 103	220041749-26 Location: Hall Between Office 6 And Stage - Drywall Lathe	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: Grey/Brown, Heterogeneous, Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose 7 %, Non-fibrous 93 %			
0410-822-200-1 200	220041749-27 Location: Office 6 - 1850's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-200-2 200	220041749-28 Location: Meeting Room - 1850's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
0410-822-200-3 200	220041749-29 Location: Office 4 - 1850's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-200-4 200	220041749-30 Location: Office 5 - 1850's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-200-5 200	220041749-31 Location: School Room - 1850's Plaster (Skim Coat / White)	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-201-1 201	220041749-32 Location: Meeting Room - Textured Ceiling Materials	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/15/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-201-2 201	220041749-33 Location: Meeting Room - Textured Ceiling Materials	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/16/20
Analyst Description: White, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-300-1 300	220041749-34 Location: Open Sitting Area - 12" x 12" Floor Tile (Red)	Yes	4.3 % (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Red, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Chrysotile 4.3 % Other Material: Non-fibrous 13 %			
0410-822-300-2 300	220041749-35 Location: Open Sitting Area - 12" x 12" Floor Tile (Red)		NA/PS
Analyst Description: Bulk Material Asbestos Types: Other Material:			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-300A-1 300A	220041749-36 Location: Open Sitting Area - 12" x 12" Floor Tile Mastic (Yellow)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 15.4 %			
0410-822-300A-2 300A	220041749-37 Location: Open Sitting Area - 12" x 12" Floor Tile Mastic (Yellow)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 18.4 %			
0410-822-301-1 301	220041749-38 Location: Meeting Room - 12" x 12" Floor Tile (White W/ Streaks)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 3.9 %			
0410-822-301-2 301	220041749-39 Location: Meeting Room - 12" x 12" Floor Tile (White W/ Streaks)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 7 %			
0410-822-301A-1 301A	220041749-40 Location: Meeting Room - 12" x 12" Floor Tile Mastic (White)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 8.6 %			
0410-822-301A-2 301A	220041749-41 Location: Meeting Room - 12" x 12" Floor Tile Mastic (White)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 15.5 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-302-1 302	220041749-42 Location: Meeting Room - Floor Tile Vapor Barrier	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 12.3 %			
0410-822-302-2 302	220041749-43 Location: Meeting Room - Floor Tile Vapor Barrier	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 11.7 %			
0410-822-303-1 303	220041749-44 Location: Kitchen - 12" x 12" Floor Tile (Yellow)	Yes	Trace (<0.25 % pc) ² (EPA 400 PC) by Jared C. Clarke on 04/16/20
Analyst Description: Yellow/Brown, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile <0.25 % pc			
Other Material: Non-fibrous 4.6 %			
0410-822-303-2 303	220041749-45 Location: Kitchen - 12" x 12" Floor Tile (Yellow)	Yes	Trace (<0.25 % pc) ² (EPA 400 PC) by Jared C. Clarke on 04/16/20
Analyst Description: Yellow/Brown, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile <0.25 % pc			
Other Material: Non-fibrous 4 %			
0410-822-303A-1 303A	220041749-46 Location: Kitchen - 12" x 12" Floor Tile Mastic (Yellow)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Yellow/Brown, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 30 %			
0410-822-303A-2 303A	220041749-47 Location: Kitchen - 12" x 12" Floor Tile Mastic (Yellow)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Yellow/Brown, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 34.8 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-304-1 304	220041749-48 Location: Office 6 - 12" x 12" Floor Tile (Beige W/ Streaks)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Tan, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 1.7 %			
0410-822-304-2 304	220041749-49 Location: Office 6 - 12" x 12" Floor Tile (Beige W/ Streaks)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Brown, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 0.9 %			
0410-822-304A-1 304A	220041749-50 Location: Office 6 - 12" x 12" Floor Tile Mastic (Black)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 3.6 %			
0410-822-304A-2 304A	220041749-51 Location: Office 6 - 12" x 12" Floor Tile Mastic (Black)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 1.4 %			
0410-822-305-1 305	220041749-52 Location: Bathroom 1 - Linoleum (Green Square Pattern)	Yes	4.3 % (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Cream/Green, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile 4.3 %			
Other Material: Non-fibrous 14.1 %			
0410-822-305-2 305	220041749-53 Location: Bathroom 1 - Linoleum (Green Square Pattern)		NA/PS
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-306-1 306	220041749-54 Location: Bathroom 2 - Linoleum (Flower Square Pattern)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 14.4 %			
0410-822-306-2 306	220041749-55 Location: Bathroom 2 - Linoleum (Flower Square Pattern)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Beige, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 10.6 %			
0410-822-307-1 307	220041749-56 Location: Bathroom 1 - Linoleum Mastic (Yellow)	Yes	12.9 % (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Yellow, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile 12.9 %			
Other Material: Non-fibrous 41.9 %			
0410-822-307-2 307	220041749-57 Location: Bathroom 2 - Linoleum Mastic (Yellow)		NA/PS
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			
0410-822-309-1 309	220041749-58 Location: School Room - Linoleum (Star Pattern)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 1 %			
0410-822-309-2 309	220041749-59 Location: School Room - Linoleum (Star Pattern)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 0.8 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-310-1 310	220041749-60 Location: Stairs By Boiler - Linoleum (Brick Pattern)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Brown, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 6.9 %			
0410-822-310-2 310	220041749-61 Location: Stairs By Boiler - Linoleum (Brick Pattern)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Brown, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 17.7 %			
0410-822-311-1 311	220041749-62 Location: School Room - Linoleum Mastic (Brown)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 2.8 %			
0410-822-311-2 311	220041749-63 Location: School Room - Linoleum Mastic (Brown)	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 45.1 %			
0410-822-400-1 400	220041749-64 Location: Boiler - Mud Elbow	Yes	26.7 % (by NYS ELAP 198.1) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 26.7 %			
Other Material: Non-fibrous 73.3 %			
0410-822-400-2 400	220041749-65 Location: Meeting Room - Mud Elbow		NA/PS
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-400-3 400	220041749-66 Location: Kitchen - Mud Elbow		NA/PS
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			
0410-822-401-1 401	220041749-67 Location: Boiler - Aircell Pipe Insulation	Yes	66.7 % (by NYS ELAP 198.1) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Chrysotile 66.7 %			
Other Material: Cellulose 29 %, Non-fibrous 4.3 %			
0410-822-401-2 401	220041749-68 Location: Meeting Room - Aircell Pipe Insulation		NA/PS
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			
0410-822-401-3 401	220041749-69 Location: Kitchen - Aircell Pipe Insulation		NA/PS
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			
0410-822-402-1 402	220041749-70 Location: Boiler Room - Mag Insulation	Yes	12.1 % (by NYS ELAP 198.1) by Jared C. Clarke on 04/16/20
Analyst Description: White, Homogeneous, Fibrous, Bulk Material			
Asbestos Types: Crocidolite 6.1 %, Chrysotile 6.1 %			
Other Material: Non-fibrous 87.9 %			
0410-822-402-2 402	220041749-71 Location: Boiler Room - Mag Insulation		NA/PS
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-402-3 402	220041749-72 Location: Boiler Room - Mag Insulation		NA/PS
Analyst Description: Bulk Material Asbestos Types: Other Material:			
0410-822-603-1 603	220041749-73 Location: Exterior - 1850's Window Caulk	Yes	2.1 % (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Chrysotile 2.1 % Other Material: Non-fibrous 16.4 %			
0410-822-603-2 603	220041749-74 Location: Exterior - 1850's Window Caulk		NA/PS
Analyst Description: Bulk Material Asbestos Types: Other Material:			
0410-822-604-1 604	220041749-75 Location: Exterior - 1850's Window Glazing	Yes	Trace (<0.25 % pc) ² (EPA 400 PC) by Jared C. Clarke on 04/16/20
Analyst Description: Grey/Yellow, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Chrysotile <0.25 % pc, Anthophyllite <0.25 % pc Other Material: Fibrous Talc 2 %, Non-fibrous 33.4 %			
0410-822-604-2 604	220041749-76 Location: Exterior - 1850's Window Glazing	Yes	Trace (<0.25 % pc) ² (EPA 400 PC) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Chrysotile <0.25 % pc, Anthophyllite <0.25 % pc Other Material: Fibrous Talc 2 %, Non-fibrous 19.5 %			
0410-822-605-1 605	220041749-77 Location: Exterior - Addition Window Caulk	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: White/Grey, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 4.2 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-605-2 605	220041749-78 Location: Exterior - Addition Window Caulk	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: White/Grey, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 4.2 %			
0410-822-606-1 606	220041749-79 Location: Exterior - Addition Window Glazing	Yes	Trace (<0.25 % pc) ² (EPA 400 PC) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Anthophyllite <0.25 % pc			
Other Material: Non-fibrous 14.7 %			
0410-822-606-2 606	220041749-80 Location: Exterior - Addition Window Glazing	Yes	Trace (<0.25 % pc) ² (EPA 400 PC) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Anthophyllite <0.25 % pc			
Other Material: Fibrous Talc Trace, Non-fibrous 13 %			
0410-822-700-1 700	220041749-81 Location: Exterior - Field Felt	Yes	5.3 % (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile 5.3 %			
Other Material: Non-fibrous 17.3 %			
0410-822-700-2 700	220041749-82 Location: Exterior - Field Felt		NA/PS
Analyst Description: Bulk Material			
Asbestos Types:			
Other Material:			
0410-822-701-1 701	220041749-83 Location: Exterior - Flashing Felt	Yes	4.3 % (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile 4.3 %			
Other Material: Non-fibrous 13.8 %			

Client Name: Stohl Environmental, LLC.

PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-701-2 701	220041749-84 Location: Exterior - Flashing Felt		NA/PS
Analyst Description: Bulk Material Asbestos Types: Other Material:			
0410-822-703-1 703	220041749-85 Location: Exterior - Roof Deck	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-703-2 703	220041749-86 Location: Exterior - Roof Deck	No	NAD (by NYS ELAP 198.1) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 100 %			
0410-822-705-1 705	220041749-87 Location: Exterior - Repair Tar	Yes	4.6 % (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Chrysotile 4.6 % Other Material: Non-fibrous 11.4 %			
0410-822-706-1 706	220041749-88 Location: Exterior - Hot Mop	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 2.3 %			
0410-822-706-2 706	220041749-89 Location: Exterior - Hot Mop	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Black, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 5.8 %			

Client Name: Stohl Environmental, LLC.

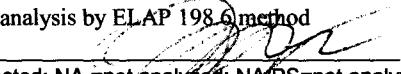
PLM Bulk Asbestos Report

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
0410-822-707-1 707	220041749-90 Location: Exterior - Roof Caulk	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 10.9 %			
0410-822-707-2 707	220041749-91 Location: Exterior - Roof Caulk	No	NAD (by NYS ELAP 198.6) by Jared C. Clarke on 04/16/20
Analyst Description: Grey, Homogeneous, Non-Fibrous, Bulk Material Asbestos Types: Other Material: Non-fibrous 13.1 %			

Reporting Notes:

- (1) This PLM job was analyzed using Motic BA310 Pol Scope S/N 1190000326
- (2) Sample prepared for analysis by ELAP 198.6 method

Analyzed by: Jared C. Clarke 

*NAD/NSD =no asbestos detected; NA =not analyzed; NA/PS=not analyzed/positive stop, (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; PLM Bulk Asbestos Analysis by Appd E to Subpt E, 40 CFR 763 (NVLAP 200546-0), ELAP PLM Method 198.1 for NY friable samples, which includes the identification and quantitation of vermiculite or ELAP 198.6 for NOB samples or EPA 400 pt ct by EPA 600-M4-82-020 (NY ELAP Lab 11480); Note:PLM is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non asbestos-containing in NY State (also see EPA Advisory for floor tile, FR 59,146,38970,8/1/94) National Institute of Standards and Technology Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the lab.This PLM report relates ONLY to the items tested. AIHA-LAP, LLC Lab ID 102843, RI Cert AAL-094, CT Cert PH-0186, Mass Cert AA000054.

Reviewed By:  _____ END OF REPORT _____

Client Name: Stohl Environmental, LLC.

Table I
Summary of Bulk Asbestos Analysis Results

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
01	0410-822-100B-1	100B	----	----	----	----	NAD	NA
	Location: Office 6 - 1850's Plaster (Skim Coat / Gray)							
02	0410-822-100B-2	100B	----	----	----	----	NAD	NA
	Location: Meeting Room - 1850's Plaster (Skim Coat / Gray)							
03	0410-822-100B-3	100B	----	----	----	----	NAD	NA
	Location: Office 4 - 1850's Plaster (Skim Coat / Gray)							
04	0410-822-100B-4	100B	----	----	----	----	NAD	NA
	Location: Office 4 - 1850's Plaster (Skim Coat / Gray)							
05	0410-822-100B-5	100B	----	----	----	----	NAD	NA
	Location: Office 4 - 1850's Plaster (Skim Coat / Gray)							
06	0410-822-100C-1	100C	----	----	----	----	NAD	NA
	Location: Office 6 - 1850's Plaster (Base Coat)							
07	0410-822-100C-2	100C	----	----	----	----	NAD	NA
	Location: Office 4 - 1850's Plaster (Base Coat)							
08	0410-822-100C-3	100C	----	----	----	----	NAD	NA
	Location: Office 4 - 1850's Plaster (Base Coat)							
09	0410-822-100C-4	100C	----	----	----	----	NAD	NA
	Location: Kitchen - 1850's Plaster (Base Coat)							
10	0410-822-100C-5	100C	----	----	----	----	NAD	NA
	Location: Meeting Room - 1850's Plaster (Base Coat)							
11	0410-822-101A-1	101A	----	----	----	----	NAD	NA
	Location: Stage - 1900's Plaster (Skim Coat / White)							
12	0410-822-101A-2	101A	----	----	----	----	NAD	NA
	Location: Office 3 - 1900's Plaster (Skim Coat / White)							
13	0410-822-101A-3	101A	----	----	----	----	NAD	NA
	Location: Stage - 1900's Plaster (Skim Coat / White)							
14	0410-822-101A-4	101A	----	----	----	----	NAD	NA
	Location: Open Sitting Area - 1900's Plaster (Skim Coat / White)							
15	0410-822-101A-5	101A	----	----	----	----	NAD	NA
	Location: Office 2 - 1900's Plaster (Skim Coat / White)							
16	0410-822-101B-1	101B	----	----	----	----	NAD	NA
	Location: Office 3 - 1900's Plaster (Base Coat / Gray)							

See Reporting notes on last page

Client Name: Stohl Environmental, LLC.

Table I
Summary of Bulk Asbestos Analysis Results

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
17	0410-822-101B-2	101B	----	----	----	----	NAD	NA
	Location: School Room - 1900's Plaster (Base Coat / Gray)							
18	0410-822-101B-3	101B	----	----	----	----	NAD	NA
	Location: Hall Between Office 6 And Stage - 1900's Plaster (Base Coat / Gray)							
19	0410-822-101B-4	101B	----	----	----	----	NAD	NA
	Location: Open Sitting Area - 1900's Plaster (Base Coat / Gray)							
20	0410-822-101B-5	101B	----	----	----	----	NAD	NA
	Location: Office 2 - 1900's Plaster (Base Coat / Gray)							
21	0410-822-102-1	102	----	----	----	----	NAD	NA
	Location: Open Sitting Area - Drywall							
22	0410-822-102-2	102	----	----	----	----	NAD	NA
	Location: Boiler - Drywall							
23	0410-822-102A-1	102A	----	----	----	----	NAD	NA
	Location: Open Sitting Area - Joint Compound							
24	0410-822-102A-2	102A	----	----	----	----	NAD	NA
	Location: Boiler - Joint Compound							
25	0410-822-103-1	103	----	----	----	----	NAD	NA
	Location: Hall Between Office 6 And Stage - Drywall Lathe							
26	0410-822-103-2	103	----	----	----	----	NAD	NA
	Location: Hall Between Office 6 And Stage - Drywall Lathe							
27	0410-822-200-1	200	----	----	----	----	NAD	NA
	Location: Office 6 - 1850's Plaster (Skim Coat / White)							
28	0410-822-200-2	200	----	----	----	----	NAD	NA
	Location: Meeting Room - 1850's Plaster (Skim Coat / White)							
29	0410-822-200-3	200	----	----	----	----	NAD	NA
	Location: Office 4 - 1850's Plaster (Skim Coat / White)							
30	0410-822-200-4	200	----	----	----	----	NAD	NA
	Location: Office 5 - 1850's Plaster (Skim Coat / White)							
31	0410-822-200-5	200	----	----	----	----	NAD	NA
	Location: School Room - 1850's Plaster (Skim Coat / White)							
32	0410-822-201-1	201	----	----	----	----	NAD	NA
	Location: Meeting Room - Textured Ceiling Materials							

Client Name: Stohl Environmental, LLC.

Table I
Summary of Bulk Asbestos Analysis Results

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
33	0410-822-201-2	201	----	----	----	----	NAD	NA
	Location: Meeting Room - Textured Ceiling Materials							
34	0410-822-300-1	300	0.214	26.5	56.2	13.0	Chrysotile 4.3	NA
	Location: Open Sitting Area - 12" x 12" Floor Tile (Red)							
35	0410-822-300-2	300	0.917	83.3	12.5	4.2	NA/PS	NA
	Location: Open Sitting Area - 12" x 12" Floor Tile (Red)							
36	0410-822-300A-1	300A	0.200	65.7	18.8	15.4	NAD	NAD
	Location: Open Sitting Area - 12" x 12" Floor Tile Mastic (Yellow)							
37	0410-822-300A-2	300A	0.233	66.8	14.9	18.4	NAD	NAD
	Location: Open Sitting Area - 12" x 12" Floor Tile Mastic (Yellow)							
38	0410-822-301-1	301	0.227	21.0	75.0	3.9	NAD	NAD
	Location: Meeting Room - 12" x 12" Floor Tile (White W/ Streaks)							
39	0410-822-301-2	301	0.232	22.0	71.0	7.0	NAD	NAD
	Location: Meeting Room - 12" x 12" Floor Tile (White W/ Streaks)							
40	0410-822-301A-1	301A	0.251	77.7	13.7	8.6	NAD	NAD
	Location: Meeting Room - 12" x 12" Floor Tile Mastic (White)							
41	0410-822-301A-2	301A	0.238	62.7	21.8	15.5	NAD	NAD
	Location: Meeting Room - 12" x 12" Floor Tile Mastic (White)							
42	0410-822-302-1	302	0.318	61.1	26.6	12.3	NAD	NAD
	Location: Meeting Room - Floor Tile Vapor Barrier							
43	0410-822-302-2	302	0.157	70.1	18.2	11.7	NAD	NAD
	Location: Meeting Room - Floor Tile Vapor Barrier							
44	0410-822-303-1	303	0.246	18.4	77.0	3.0	Chrysotile <0.25	Chrysotile 1.6
	Location: Kitchen - 12" x 12" Floor Tile (Yellow)							
45	0410-822-303-2	303	0.236	18.7	77.2	4.0	Chrysotile <0.25	NA/PS
	Location: Kitchen - 12" x 12" Floor Tile (Yellow)							
46	0410-822-303A-1	303A	0.098	61.6	8.4	30.0	NAD	NAD
	Location: Kitchen - 12" x 12" Floor Tile Mastic (Yellow)							
47	0410-822-303A-2	303A	0.107	64.7	0.6	34.8	NAD	NAD
	Location: Kitchen - 12" x 12" Floor Tile Mastic (Yellow)							
48	0410-822-304-1	304	0.241	16.8	81.5	1.7	NAD	NAD
	Location: Office 6 - 12" x 12" Floor Tile (Beige W/ Streaks)							

See Reporting notes on last page

Client Name: Stohl Environmental, LLC.

Table I
Summary of Bulk Asbestos Analysis Results

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
49	0410-822-304-2	304	0.266	20.0	79.1	0.9	NAD	NAD
	Location: Office 6 - 12" x 12" Floor Tile (Beige W/ Streaks)							
50	0410-822-304A-1	304A	0.055	60.1	36.3	3.6	NAD	NAD
	Location: Office 6 - 12" x 12" Floor Tile Mastic (Black)							
51	0410-822-304A-2	304A	0.058	72.2	26.4	1.4	NAD	NAD
	Location: Office 6 - 12" x 12" Floor Tile Mastic (Black)							
52	0410-822-305-1	305	0.300	56.9	24.7	14.1	Chrysotile 4.3	NA
	Location: Bathroom 1 - Linoleum (Green Square Pattern)							
53	0410-822-305-2	305	0.400	54.6	22.8	22.6	NA/PS	NA
	Location: Bathroom 1 - Linoleum (Green Square Pattern)							
54	0410-822-306-1	306	0.336	47.6	37.9	14.4	NAD	NAD
	Location: Bathroom 2 - Linoleum (Flower Square Pattern)							
55	0410-822-306-2	306	0.247	47.4	42.0	10.6	NAD	NAD
	Location: Bathroom 2 - Linoleum (Flower Square Pattern)							
56	0410-822-307-1	307	0.254	36.6	8.6	41.9	Chrysotile 12.9	NA
	Location: Bathroom 1 - Linoleum Mastic (Yellow)							
57	0410-822-307-2	307	0.280	50.6	8.9	40.6	NA/PS	NA
	Location: Bathroom 2 - Linoleum Mastic (Yellow)							
58	0410-822-309-1	309	0.254	72.0	27.0	1.0	NAD	NAD
	Location: School Room - Linoleum (Star Pattern)							
59	0410-822-309-2	309	0.221	68.0	31.2	0.8	NAD	NAD
	Location: School Room - Linoleum (Star Pattern)							
60	0410-822-310-1	310	0.184	40.7	52.4	6.9	NAD	NAD
	Location: Stairs By Boiler - Linoleum (Brick Pattern)							
61	0410-822-310-2	310	0.135	44.0	38.3	17.7	NAD	NAD
	Location: Stairs By Boiler - Linoleum (Brick Pattern)							
62	0410-822-311-1	311	0.061	73.1	24.1	2.8	NAD	NAD
	Location: School Room - Linoleum Mastic (Brown)							
63	0410-822-311-2	311	0.106	42.7	12.2	45.1	NAD	NAD
	Location: School Room - Linoleum Mastic (Brown)							
64	0410-822-400-1	400	---	---	---	---	Chrysotile 26.7	NA
	Location: Boiler - Mud Elbow							

Client Name: Stohl Environmental, LLC.

Table I
Summary of Bulk Asbestos Analysis Results

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
65	0410-822-400-2	400	----	----	----	----	NA/PS	NA
	Location: Meeting Room - Mud Elbow							
66	0410-822-400-3	400	----	----	----	----	NA/PS	NA
	Location: Kitchen - Mud Elbow							
67	0410-822-401-1	401	----	----	----	----	Chrysotile 66.7	NA
	Location: Boiler - Aircell Pipe Insulation							
68	0410-822-401-2	401	----	----	----	----	NA/PS	NA
	Location: Meeting Room - Aircell Pipe Insulation							
69	0410-822-401-3	401	----	----	----	----	NA/PS	NA
	Location: Kitchen - Aircell Pipe Insulation							
70	0410-822-402-1	402	----	----	----	----	Crocidolite 6.1 Chrysotile 6.1	NA
	Location: Boiler Room - Mag Insulation							
71	0410-822-402-2	402	----	----	----	----	NA/PS	NA
	Location: Boiler Room - Mag Insulation							
72	0410-822-402-3	402	----	----	----	----	NA/PS	NA
	Location: Boiler Room - Mag Insulation							
73	0410-822-603-1	603	0.345	7.6	73.8	16.4	Chrysotile 2.1	NA
	Location: Exterior - 1850's Window Caulk							
74	0410-822-603-2	603	0.317	29.3	45.7	24.9	NA/PS	NA
	Location: Exterior - 1850's Window Caulk							
75	0410-822-604-1	604	0.481	22.7	41.9	33.5	Chrysotile <0.25 Anthophyllite <0.25	Chrysotile Trace Anthophyllite 1.8
	Location: Exterior - 1850's Window Glazing							
76	0410-822-604-2	604	0.353	7.9	70.6	21.5	Chrysotile <0.25 Anthophyllite <0.25	NA/PS
	Location: Exterior - 1850's Window Glazing							
77	0410-822-605-1	605	0.153	26.0	69.9	4.2	NAD	NAD
	Location: Exterior - Addition Window Caulk							
78	0410-822-605-2	605	0.160	28.3	67.4	4.2	NAD	NAD
	Location: Exterior - Addition Window Caulk							
79	0410-822-606-1	606	0.380	11.8	73.5	14.6	Anthophyllite <0.25	Anthophyllite Trace
	Location: Exterior - Addition Window Glazing							
80	0410-822-606-2	606	0.398	8.0	79.0	12.9	Anthophyllite <0.25	Anthophyllite Trace
	Location: Exterior - Addition Window Glazing							

See Reporting notes on last page

Client Name: Stohl Environmental, LLC.

Table I
Summary of Bulk Asbestos Analysis Results

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls


AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
81	0410-822-700-1	700	0.263	72.6	4.7	17.3	Chrysotile 5.3	NA
Location: Exterior - Field Felt								
82	0410-822-700-2	700	0.462	75.2	4.8	20.0	NA/PS	NA
Location: Exterior - Field Felt								
83	0410-822-701-1	701	0.601	79.8	2.1	13.8	Chrysotile 4.3	NA
Location: Exterior - Flashing Felt								
84	0410-822-701-2	701	0.285	87.3	2.8	10.0	NA/PS	NA
Location: Exterior - Flashing Felt								
85	0410-822-703-1	703	----	----	----	----	NAD	NA
Location: Exterior - Roof Deck								
86	0410-822-703-2	703	----	----	----	----	NAD	NA
Location: Exterior - Roof Deck								
87	0410-822-705-1	705	0.389	53.2	30.8	11.4	Chrysotile 4.6	NA
Location: Exterior - Repair Tar								
88	0410-822-706-1	706	0.224	91.0	6.7	2.3	NAD	NAD
Location: Exterior - Hot Mop								
89	0410-822-706-2	706	0.262	91.5	2.7	5.8	NAD	NAD
Location: Exterior - Hot Mop								
90	0410-822-707-1	707	0.226	69.4	19.8	10.9	NAD	NAD
Location: Exterior - Roof Caulk								
91	0410-822-707-2	707	0.219	66.4	20.5	13.1	NAD	NAD
Location: Exterior - Roof Caulk								

Client Name: Stohl Environmental, LLC.

**Table I
Summary of Bulk Asbestos Analysis Results**

2020-279; Niagara University; 822 Cleveland Ave., Niagara Falls - 822 Cleveland Ave., Niagara Falls

AmeriSci Sample #	Client Sample#	HG Area	Sample Weight (gram)	Heat Sensitive Organic %	Acid Soluble Inorganic %	Insoluble Non-Asbestos Inorganic %	** Asbestos % by PLM/DS	** Asbestos % by TEM
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Analyzed by: M Peysakhov-Hitachi#747/Noran ; Date Analyzed 4/16/2020

**Quantitative Analysis (Semi/Full); Bulk Asbestos Analysis - PLM by Appd E to Subpt E, 40 CFR 763 or NYSDOH ELAP 198.1 for New York friable samples or NYSDOH ELAP 198.6 for New York NOB samples; TEM (Semi/Full) by EPA 600/R-93/116 (or NYSDOH ELAP 198.4; for New York samples); NAD = no asbestos detected during a quantitative analysis; NA = not analyzed; Trace = <1%; (SOF-V) = Sprayed On Fireproofing containing Vermiculite; (SM-V) = Surfacing Material containing Vermiculite; Quantitation for beginning weights of <0.1 grams should be considered as qualitative only; Qualitative Analysis: Asbestos analysis results of "Present" or "NVA = No Visible Asbestos" represents results for Qualitative PLM or TEM Analysis only (no accreditation coverage available from any regulatory agency for qualitative analyses); NVLAP (PLM) 200546-0, NYSDOH ELAP Lab 11480, AIHA-LAP, LLC (PLM) Lab ID 102843.

Warning Note: PLM limitation, only TEM will resolve fibers <0.25 micrometers in diameter. TEM bulk analysis is representative of the fine grained matrix material and may not be representative of non-uniformly dispersed debris for which PLM evaluation is recommended (i.e. soils and other heterogenous materials).

Reviewed By: 



Chain of Custody Document

3860 California Road, Orchard Park, New York 14127
 PHONE (716) 312-0070 FAX (716) 312-8092
 WWW.STOHLENVIRONMENTAL.COM

Submitted to: (Lab Name) AmeriSci - NY

STOHL Job # 2020-279

Client: Niagara University Contact: Lori Caccammise
 Building: 822 Cleveland Ave, Niagara Falls Location: 822 Cleveland Ave, Niagara Falls

LEAD Wipes _____ Soil: _____ Bulk: _____
 ASTM wipes were used

PCB's EPA 8082 _____

RUSH _____ Hr *Turnaround*
 24 Hour 72 Hour
 48 Hour 5 Day

HAN #	Material Description	Sample #	Location of Sample
100B	1850's Plaster Skim Coat - Grey	0410-822-100B- 1	Office 6
100B	1850's Plaster Skim Coat - Grey	0410-822-100B- 2	Meeting Room
100B	1850's Plaster Skim Coat - Grey	0410-822-100B- 3	Office 4
100B	1850's Plaster Skim Coat - Grey	0410-822-100B- 4	Office 4
100B	1850's Plaster Skim Coat - Grey	0410-822-100B- 5	Office 4
100C	1850'S Plaster Base Coat	0410-822-100C- 1	Office 6
100C	1850'S Plaster Base Coat	0410-822-100C- 2	Office 4
100C	1850'S Plaster Base Coat	0410-822-100C- 3	Office 4
100C	1850'S Plaster Base Coat	0410-822-100C- 4	Kitchen
100C	1850'S Plaster Base Coat	0410-822-100C- 5	Meeting Room
101A	1900's Plaster Skim Coat - White	0410-822-101A- 1	Stage
101A	1900's Plaster Skim Coat - White	0410-822-101A- 2	Office 3
101A	1900's Plaster Skim Coat - White	0410-822-101A- 3	Stage
101A	1900's Plaster Skim Coat - White	0410-822-101A- 4	Open Sitting Area
101A	1900's Plaster Skim Coat - White	0410-822-101A- 5	Office 2
101B	1900's Plaster Base Coat - Grey	0410-822-101B- 1	Office 3
101B	1900's Plaster Base Coat - Grey	0410-822-101B- 2	School Room
101B	1900's Plaster Base Coat - Grey	0410-822-101B- 3	Hall Between Office 6 and Stage
101B	1900's Plaster Base Coat - Grey	0410-822-101B- 4	Open Sitting Area
101B	1900's Plaster Base Coat - Grey	0410-822-101B- 5	Office 2
102	Drywall	0410-822-102- 1	Open Sitting Area
102	Drywall	0410-822-102- 2	Boiler
102A	Joint Compound	0410-822-102A- 1	Open Sitting Area
102A	Joint Compound	0410-822-102A- 2	Boiler
103	Drywall Lathe	0410-822-103- 1	Hall Between Office 6 and Stage
103	Drywall Lathe	0410-822-103- 2	Hall Between Office 6 and Stage
200	1850's Plaster Skim Coat - White	0410-822-200- 1	Office 6

Note 1: Stop at first positive for homogeneous materials. Perform full NYS ELAP PLM/TEM Protocol for all samples.
 Notes:
 Please e-mail lab results to labs@stohlenv.com If checked, also e-mail results to: Crilly@stohlenv.com

Sampled By: [Signature] Print Name Connor Crilly Date: 4/10/20
 Relinquished By: [Signature] Print Name Connor Crilly Date: 4/10/20
 Received By: [Signature] Date: 4/15/20 lls

220041749



Chain of Custody Document

3860 California Road, Orchard Park, New York 14127
 PHONE (716) 312-0070 FAX (716) 312-8092
 WWW.STOHLENVIRONMENTAL.COM

Submitted to: (Lab Name)

AmeriSci - NY

STOHL Job #

2020-279

Client: Niagara University Contact: Lori Caccammise
 Building: 822 Cleveland Ave, Niagara Falls Location: 822 Cleveland Ave, Niagara Falls

LEAD Wipes _____ Soil: _____ Bulk: _____
 ASTM wipes were used

PCB's EPA 8082 _____

RUSH _____ Hr

Turnaround
 24 Hour 72 Hour
 48 Hour 5 Day

HAN #	Material Description	Sample #	Location of Sample
200	1850's Plaster Skim Coat - White	0410-822-200- 2	Meeting Room
200	1850's Plaster Skim Coat - White	0410-822-200- 3	Office 4
200	1850's Plaster Skim Coat - White	0410-822-200- 4	Office 5
200	1850's Plaster Skim Coat - White	0410-822-200- 5	School Room
201	Textured Ceiling Materials	0410-822-201- 1	Meeting Room
201	Textured Ceiling Materials	0410-822-201- 2	Meeting Room
300	12"x12" Floor Tile - Red	0410-822-300- 1	Open Sitting Area
300	12"x12" Floor Tile - Red	0410-822-300- 2	Open Sitting Area
300A	12"x12" Floor Tile Mastic - Yellow	0410-822-300A- 1	Open Sitting Area
300A	12"x12" Floor Tile Mastic - Yellow	0410-822-300A- 2	Open Sitting Area
301	12"x12" Floor Tile white w/ Streaks	0410-822-301- 1	Meeting Room
301	12"x12" Floor Tile White w/ Streaks	0410-822-301- 2	Meeting Room
301A	12"x12" Floor Tile Mastic - White	0410-822-301A- 1	Meeting Room
301A	12"x12" Floor Tile Mastic - White	0410-822-301A- 2	Meeting Room
302	Floor Tile Vapor Barrier	0410-822-302- 1	Meeting Room
302	Floor Tile Vapor Barrier	0410-822-302- 2	Meeting Room
303	12"x12" Floor Tile - Yellow	0410-822-303- 1	Kitchen
303	12"x12" Floor Tile - Yellow	0410-822-303- 2	Kitchen
303A	12"x12" Yellow Floor Tile Mastic - Yellow	0410-822-303A- 1	Kitchen
303A	12"x12" Yellow Floor Tile Mastic - Yellow	0410-822-303A- 2	Kitchen
304	12"x12" Floor Tile - Beige w/ Streaks	0410-822-304- 1	Office 6
304	12"x12" Floor Tile - Beige w/ Streaks	0410-822-304- 2	Office 6
304A	12"x12" Floor Tile Mastic - Black	0410-822-304A- 1	Office 6
304A	12"x12" Floor Tile Mastic - Black	0410-822-304A- 2	Office 6
305	Linoleum Green Square Pattern	0410-822-305- 1	Bathroom 1
305	Linoleum Green Square Pattern	0410-822-305- 2	Bathroom 1
306	Linoleum Flower Pattern Square	0410-822-306- 1	Bathroom 2

Note 1: Stop at first positive for homogeneous materials. Perform full NYS ELAP PLM/TEM Protocol for all samples.
 Notes:
 Please e-mail lab results to labs@stohlenv.com If checked, also e-mail results to: CCrilly@stohl Env.com

Sampled By: [Signature] Print Name Connor Crilly Date: 4/10/2020
 Relinquished By: [Signature] Print Name Connor Crilly Date: 4/10/2020
 Received By: [Signature] Date: 4/15/20 1115

220041749



Chain of Custody Document

3860 California Road, Orchard Park, New York 14127
 PHONE (716) 312-0070 FAX (716) 312-8092
 WWW.STOHLENVIRONMENTAL.COM

Submitted to: (Lab Name) AmeriSci - NY

STOHL Job # 2020-279

Client: Niagara University Contact: Lori Caccammise
 Building: 822 Cleveland Ave, Niagara Falls Location: 822 Cleveland Ave, Niagara Falls

LEAD Wipes _____ Soil: _____ Bulk: _____ *ASTM.wipes were used*	PCB's EPA 8082 _____	RUSH _____ Hr	<i>Turnaround</i> <input type="checkbox"/> 24 Hour <input checked="" type="checkbox"/> 72 Hour <input type="checkbox"/> 48 Hour <input type="checkbox"/> 5 Day
--	--------------------------------	---------------	--

HAN #	Material Description	Sample #	Location of Sample
306	Linoleum Flower Pattern Square	0410-822-306- 2	Bathroom 2
307	Linoleum Mastic - Yellow	0410-822-307- 1	Bathroom 1
307	Linoleum Mastic - Yellow	0410-822-307- 2	Bathroom 2
309	Linoleum Star Pattern	0410-822-309- 1	School Room
309	Linoleum Star Pattern	0410-822-309- 2	School Room
310	Linoleum Brick Pattern	0410-822-310- 1	Stairs by Boiler
310	Linoleum Brick Pattern	0410-822-310- 2	Stairs by Boiler
311	Linoleum Mastic - Brown	0410-822-311- 1	School Room
311	Linoleum Mastic - Brown	0410-822-311- 2	School Room
400	Mud Elbow	0410-822-400- 1	Boiler
400	Mud Elbow	0410-822-400- 2	Meeting Room
400	Mud Elbow	0410-822-400- 3	Kitchen
401	Aircell Pipe Insulation	0410-822-401- 1	Boiler
401	Aircell Pipe Insulation	0410-822-401- 2	Meeting Room
401	Aircell Pipe Insulation	0410-822-401- 3	Kitchen
402	Mag Insulation	0410-822-402- 1	Boiler Room
402	Mag Insulation	0410-822-402- 2	Boiler Room
402	Mag Insulation	0410-822-402- 3	Boiler Room
603	1850's Window Caulk	0410-822-603- 1	Exterior
603	1850's Window Caulk	0410-822-603- 2	Exterior
604	1850's Window Glazing	0410-822-604- 1	Exterior
604	1850's Window Glazing	0410-822-604- 2	Exterior
605	Addition Window Caulk	0410-822-605- 1	Exterior
605	Addition Window Caulk	0410-822-605- 2	Exterior
606	Addition Window Glazing	0410-822-606- 1	Exterior
606	Addition Window Glazing	0410-822-606- 2	Exterior
700	Field Felt	0410-822-700- 1	Exterior

Note 1: Stop at first positive for homogeneous materials. Perform full NYS ELAP PLM/TEM Protocol for all samples.
 Notes:
 Please e-mail lab results to labs@stohlenv.com If checked, also e-mail results to: ccrilly@stohlenv.com

Sampled By: [Signature] Print Name Connor Crilly Date: 4/10/2020
 Relinquished By: [Signature] Print Name Connor Crilly Date: 4/10/2020
 Received By: [Signature] Date: 4/15/20 1115

220041749



3880 California Road, Orchard Park, New York 14127
 PHONE (716) 312-0070 FAX (716) 312-8092
 WWW.STOHLENVIRONMENTAL.COM

Chain of Custody Document

Submitted to: (Lab Name)

AmeriSci - NY

STOHL Job #

2020-279

Client: <u>Niagara University</u>		Contact: <u>Lori Caccammise</u>	
Building: <u>822 Cleveland Ave, Niagara Falls</u>		Location: <u>822 Cleveland Ave, Niagara Falls</u>	
LEAD Wipes _____ Soil: _____ Bulk: _____ *ASTM wipes were used*	PCB's EPA 8082 _____	Turnaround RUSH _____ Hr <input type="checkbox"/> 24 Hour <input checked="" type="checkbox"/> 72 Hour <input type="checkbox"/> 48 Hour <input type="checkbox"/> 5 Day	

HAN #	Material Description	Sample #	Location of Sample
700	Field Felt	0410-822-700- 2	Exterior
701	Flashing Felt	0410-822-701- 1	Exterior
701	Flashing Felt	0410-822-701- 2	Exterior
703	Roof Deck	0410-822-703- 1	Exterior
703	Roof Deck	0410-822-703- 2	Exterior
705	Repair Tar	0410-822-705-1	Exterior
706	Hot Map	0410-822-706-1	Exterior
706	Hot Map	0410-822-706-2	Exterior
707	Roof Caulk	0410-822-707-1	Exterior
707	Roof Caulk	0410-822-707-2	Exterior
#REF!	#REF!	#REF! ####	
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Note 1: Stop at first positive for homogeneous materials. Perform full NYS ELAP PLM/TEM Protocol for all samples.
 Notes:
 Please e-mail lab results to labs@stohlenv.com If checked, also e-mail results to: C Crilly @ Stohl Env.com

Sampled By: [Signature] Print Name Connor Crilly Date: 4/10/2020
 Relinquished By: [Signature] Print Name Connor Crilly Date: 4/10/2020
 Received By: [Signature] Date: 4/15/20 115

220041749



Analysis Report

Schneider Laboratories Global, Inc

2512 W. Cary Street • Richmond, Virginia • 23220-5117
804-353-6778 • 800-785-LABS (5227) • Fax 804-359-1475

Customer: Stohl Environmental, LLC (4507)
Address: 3860 California Road
Orchard Park, NY 14127-2262

Order #: 368001

Matrix Bulk
Received 04/15/20
Reported 04/16/20

Attn:
Project: 822 Cleveland Ave, Niagra Falls
Location: 822 Cleveland Ave, Niagra Falls
Number: 2020-279

PO Number:

Table with columns: Sample ID, Cust. Sample ID, Location, Parameter, Method, Result, RL*, Units, Analysis Date, Analyst. Contains two main sections for sample IDs 368001-001 and 368001-002, each listing various Aroclor compounds and PCB surrogate recoveries.

All internal QC parameters were met. Unusual sample conditions, if any, are described. Surrogate Spike results designated with "D" indicate that the analyte was diluted out. "MI" indicates matrix interference. Concentration and *Reporting Limit (RL) based on areas provided by client. Values are reported to three significant figures. Solid PPM = mg/kg | PPB = µg/kg and Water PPM = mg/L | PPB = µg/L. The test results reported relate only to the samples submitted.



Analysis Report

Schneider Laboratories Global, Inc

2512 W. Cary Street • Richmond, Virginia • 23220-5117
804-353-6778 • 800-785-LABS (5227) • Fax 804-359-1475

Customer: Stohl Environmental, LLC (4507)
Address: 3860 California Road
Orchard Park, NY 14127-2262

Order #: 368001

Matrix Bulk
Received 04/15/20
Reported 04/16/20

Attn:
Project: 822 Cleveland Ave, Niagra Falls
Location: 822 Cleveland Ave, Niagra Falls
Number: 2020-279

PO Number:

Table with columns: Sample ID, Cust. Sample ID, Location, Parameter, Method, Result, RL*, Units, Analysis Date, Analyst. Includes data for Semi-volatile Organic Compounds and PCB/DCB/TCMX surrogate recoveries.

368001-04/16/20 02:00 PM

Reviewed By: Thoria Nadiem
Analyst

All internal QC parameters were met. Unusual sample conditions, if any, are described. Surrogate Spike results designated with "D" indicate that the analyte was diluted out. "MI" indicates matrix interference. Concentration and *Reporting Limit (RL) based on areas provided by client. Values are reported to three significant figures. Solid PPM = mg/kg | PPB = µg/kg and Water PPM = mg/L | PPB = µg/L. The test results reported relate only to the samples submitted.



Customer: Stohl Environmental, LLC (4507)
Address: 3860 California Road
Orchard Park, NY 14127-2262

Order #: 368001

Matrix Bulk
Received 04/15/20
Reported 04/16/20

Attn:
Project: 822 Cleveland Ave, Niagra Falls
Location: 822 Cleveland Ave, Niagra Falls
Number: 2020-279

PO Number:

Sample ID	Cust. Sample ID	Location	Result	RL*	Units	Analysis Date	Analyst
Parameter		Method					

State Certifications

Method	Parameter	New York	Virginia
SW846 8082A	Aroclor - 1016	ELAP Certified	VELAP Certified
SW846 8082A	Aroclor - 1221	ELAP Certified	VELAP Certified
SW846 8082A	Aroclor - 1232	ELAP Certified	VELAP Certified
SW846 8082A	Aroclor - 1242	ELAP Certified	VELAP Certified
SW846 8082A	Aroclor - 1248	ELAP Certified	VELAP Certified
SW846 8082A	Aroclor - 1254	ELAP Certified	VELAP Certified
SW846 8082A	Aroclor - 1260	ELAP Certified	VELAP Certified
SW846 8082A	Aroclor - 1262	ELAP Certified	VELAP Certified
SW846 8082A	Aroclor - 1268	ELAP Certified	VELAP Certified

State	Certificate Number
New York	ELAP 61372
Virginia	VELAP 10752

All internal QC parameters were met. Unusual sample conditions, if any, are described. Surrogate Spike results designated with "D" indicate that the analyte was diluted out. "MI" indicates matrix interference. Concentration and *Reporting Limit (RL) based on areas provided by client. Values are reported to three significant figures. Solid PPM = mg/kg | PPB = µg/kg and Water PPM = mg/L | PPB = µg/L. The test results reported relate only to the samples submitted.



Chain of Custody Document

3860 California Road, Orchard Park, New York 14127
PHONE (716) 312-0070 FAX (716) 312-8092
WWW.STOHLNENVIRONMENTAL.COM

Submitted to: (Lab Name) Schneider
STOHL Job # 2020-279

Client: Niagara University Contact: Lori Caccammise
Building: 822 Cleveland Ave, Niagara Falls Location: 822 Cleveland Ave, Niagara Falls
LEAD Wipes _____ Soil: _____ Bulk: _____ *ASTM wipes were used*
PCB's EPA 8082 X **Turnaround** RUSH _____ Hr 24 Hour 72 Hour
 48 Hour 5 Day

HAN #	Material Description
603	1850's Window Caulk
605	Addition Window Caulk
<u>707</u>	<u>Roof Caulk</u>
#REF!	#REF!
#REF!	#REF!
#REF!	#REF!
#REF!	#REF!
#REF!	#REF!
#REF!	#REF!
#REF!	#REF!
#REF!	#REF!
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#REF!	#REF!
#REF!	#REF!
#REF!	#REF!

Sample #
0410-822-603- P
0410-822-605- P
<u>0410-822-707-P</u>
#REF! ####
#REF! ####
#REF! ####
#REF! ####
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Location of Sample
Exterior
Exterior
<u>Exterior</u>

368001 O 3

V:\368\368001
fghraizi 4/15/2020 9:46:07 AM
UPS 1Z2E28998462450592

Notes: PCB Samples
Please e-mail lab results to labs@stohlenv.com If checked, also e-mail results to: ccrilly@stohlenv.com

Sampled By: Connor Crilly Print Name Connor Crilly Date: 4/10/2020
Relinquished By: Connor Crilly Print Name Connor Crilly Date: 4/10/2020
Received By: _____ Date: _____

Appendix D General Conditions of Inspection

1. This inspection was limited to those areas accessible to the inspector. Stohl Environmental, LLC neither accepts nor implies any liability for ACBM that may be present between walls, floors or interstitial areas not readily accessible to the inspectors.
2. The results of the laboratory analytical reports that may be contained herein are the product of the knowledge, experience and expertise of the laboratory retained to perform such services. Stohl Environmental, LLC neither accepts nor implies any liability for the sample analysis reports.
3. Stohl Environmental, LLC neither accepts nor implies any liability for the implementation of the recommendations found within this report.
4. Stohl Environmental, LLC cannot be held responsible or liable for the misrepresentation of fact, misstatements or withholding of relevant information of those parties interviewed during this inspection.
5. This report is based on the condition and contents present at the site on the day of the inspection. Stohl Environmental, LLC is not liable for materials, chemicals or other substances of concern that may have been removed from the site, cleaned or disposed of prior to the inspection date or subsequent to that date.
6. An asbestos inspection relies heavily upon identification of homogeneous building areas (materials of like kind), with sampling and laboratory analysis then determined by the quantity of each suspect homogenous material, generally accepted inspection protocols, regulatory requirements, and the asbestos inspector's judgment. Specific sample locations are determined with the objective of selecting representative samples. As with any type of sampling, the possibility of obtaining a false positive or false negative does exist, is inherent in the sampling process, and can at times result from the fact that asbestos fibers are not always uniformly distributed throughout suspect materials. Although Stohl Environmental attempts to minimize the risk of a false positive or false negative result through a comprehensive inspection protocol, the possibility does exist, and could only be completely eliminated through laboratory analysis of 100% of each suspect material, which of course is not practical.

Appendix E Certifications and Licenses

New York State – Department of Labor

Division of Safety and Health
License and Certificate Unit
State Campus, Building 12
Albany, NY 12240

ASBESTOS HANDLING LICENSE

Stohl Environmental LLC

3860 California Road

Orchard Park, NY 14127

FILE NUMBER: 00-0041

LICENSE NUMBER: 29408

LICENSE CLASS: FULL

DATE OF ISSUE: 02/06/2020

EXPIRATION DATE: 02/28/2021

Duly Authorized Representative – Christopher C Stohl:

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.



Eileen M. Franko, Director
For the Commissioner of Labor

United States Environmental Protection Agency

This is to certify that

Stohl Environmental, LLC

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226

In the Jurisdiction of:

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires April 20, 2021

LBP-2571-1

Certification #

February 08, 2018

Issued On

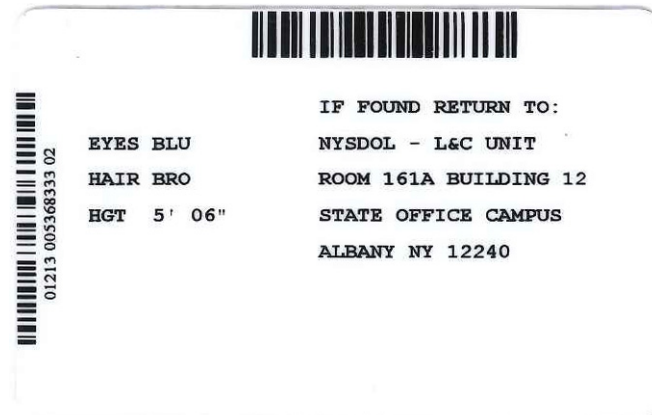
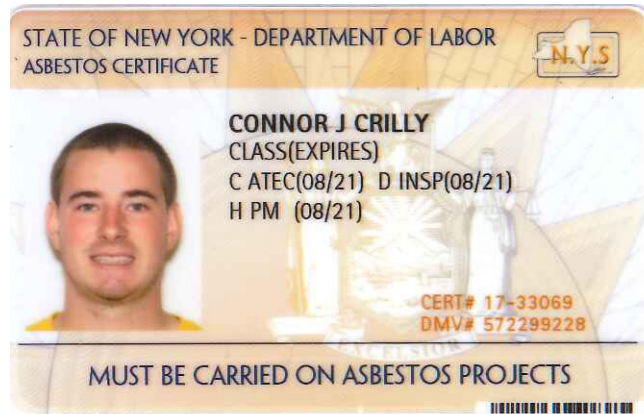


Handwritten signature of Michelle Price in black ink.

Michelle Price, Chief

Lead, Heavy Metals, and Inorganics Branch

CONNOR CRILLY



NYS ASBESTOS CERTIFICATIONS

PROJECT MONITOR

AIR MONITOR

INSPECTOR

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

1.1 BID INFORMATION

- A. Bidder: _____.
- B. Project Name: Niagara University Academic Innovation Hub – Work Force Development Training
- C. Project Location: 822 Cleveland Avenue, Niagara Falls, New York 14305
- D. Owner: Niagara University
- E. Owner Project Number: SP22-007
- F. Architect: LaBella D.P.C.
- G. Architect Project Number: 2221723

1.2 CERTIFICATIONS AND BASE BID

- A. Base Bid (Non-EDA Project Scope of Work- as indicated on sheet G001 and subsequent drawings for core and shell interior and exterior work only), Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by LaBella D.P.C. and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:
 - 1. _____ Dollars (\$_____).
 - 2. The above amount may be modified by amounts indicated by the Bidder on the attached Document 004322 "Allowances Form"
 - 3. Provide attempt to meet goals of 18% MBE and 12% WBE with participating contractors in Non-EDA Project Scope of Work.
 - 4. Bid Bond of 5% and Performance/ Payment Bond of 100% is required.

B. Base Bid (EDA Project Scope of Work- as per interior tenant build out areas only as indicated on sheet G001 and subsequent drawings), Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by LaBella D.P.C. and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

1. _____ Dollars (\$_____).
2. The above amount may be modified by amounts indicated by the Bidder on the attached Document 004322 "Allowances Form"
3. Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246 and CFR Part 60-4) goals for minority participation of 7.7% and goals for female participation of 6.9% in each trade.
4. Bid Bond of 5% and Performance/ Payment Bond of 100% is required.

1.3 BID GUARANTEE

A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within **10** days after a written Notice of Award, if offered within **60** days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5%) of the Base Bid amount above:

1. _____ Dollars (\$_____).

B. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

1.4 SUBCONTRACTORS AND SUPPLIERS

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

1. Concrete Work: _____.
2. Masonry Work: _____.
3. Roofing Work: _____.
4. Plumbing Work: _____.
5. HVAC Work: _____.
6. Electrical Work: _____.

1.5 TIME OF COMPLETION

- A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Architect, and shall fully complete the Work within **270** calendar days.

1.6 ACKNOWLEDGMENT OF ADDENDA

- A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated _____.
2. Addendum No. 2, dated _____.
3. Addendum No. 3, dated _____.
4. Addendum No. 4, dated _____.

1.7 BID SUPPLEMENTS

- A. The following supplements are a part of this Bid Form and are attached hereto.
1. Bid Form Supplement - Allowances.
 2. Bid Form Supplement - Bid Bond Form (AIA Document A310-2010).
 3. Bid Form Supplement- Non-Collusive Bidding Certificate
 4. Bid Form Supplement- Certified Corporate Resolution
 5. Bid Form Supplement- M/WBE Utilization Plan (for Non-EDA Scope of Work; and EDA Scope of Work)
 6. Bid Form Supplement- Substitution Request Form

1.8 CONTRACTOR'S LICENSE

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

1.9 SUBMISSION OF BID

- A. Respectfully submitted this ____ day of _____, 2024
- B. Submitted By: _____(Name of bidding firm or corporation).
- C. Authorized Signature: _____(Handwritten signature).
- D. Signed By: _____(Type or print name).
- E. Title: _____(Owner/Partner/President/Vice President).

- F. Witnessed By: _____ (Handwritten signature).
- G. Attest: _____ (Handwritten signature).
- H. By: _____ (Type or print name).
- I. Title: _____ (Corporate Secretary or Assistant Secretary).
- J. Street Address: _____.
- K. City, State, Zip: _____.
- L. Phone: _____.
- M. License No.: _____.
- N. Federal ID No.: _____ (Affix Corporate Seal Here).

END OF DOCUMENT 004113

DOCUMENT 004313 - BID SECURITY FORMS

1.1 BID FORM SUPPLEMENT

- A. A completed bid bond form is required to be attached to the Bid Form.

1.2 BID BOND FORM

- A. AIA Document A310-2010 "Bid Bond" is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.
 - 1. A copy of AIA Document A310, "Bid Bond," is bound in this Project Manual.

END OF DOCUMENT 004313

Bid Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

Niagara University
11 Vincentian Drive, P.O. Box 2033
Niagara Falls, New York 14109

BOND AMOUNT: \$ « »

PROJECT:
(Name, location or address, and Project number, if any)

Academic Innovation Hub – Work Force Development Training
822 Cleveland Avenue
Niagara Falls, New York 14305

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

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

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

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

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

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

Signed and sealed this « » day of « », « »

(Witness)

(Witness)

« »

(Contractor as Principal)

(Seal)

« »

(Title)

« »

(Surety)

(Seal)

« »

(Title)



DRAFT AIA[®] Document A312[™] - 2010

Payment Bond

CONTRACTOR:
(Name, legal status and address)

« »
« »

SURETY:
(Name, legal status and principal
place of business)

« »
« »

OWNER:
(Name, legal status and address)

Niagara University
11 Vincentian Drive, P.O. Box 2033
Niagara Falls, NY 14109

CONSTRUCTION CONTRACT

Date: « »

Amount: \$ « »

Description:
(Name and location)

Academic Innovation Hub – Work Force Training Center Construction
822 Cleveland Avenue
Niagara Falls, New York 14305

BOND

Date:
(Not earlier than Construction Contract Date)

« »

Amount: \$ « »

Modifications to this Bond: None See Section 18

CONTRACTOR AS PRINCIPAL
Company: (Corporate Seal)

SURETY
Company: (Corporate Seal)

Signature:
Name and « »
Title:

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

Signature:
Name and « »
Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

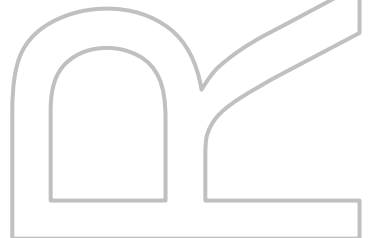
OWNER'S REPRESENTATIVE:
(Architect :)

LaBella Associates DPC
300 Pearl Street, Suite 130
Buffalo, NY 14202

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

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

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



ELECTRONIC COPYING of any portion of this AIA[®] Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 16 Definitions

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

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

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

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

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

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

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

§ 18 Modifications to this bond are as follows:

<< >>

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

CONTRACTOR AS PRINCIPAL

SURETY

Company:

(Corporate Seal)

Company:

(Corporate Seal)

Signature:

Name and Title:

Address:

<< >>
<< >>

Signature:

Name and Title:

Address:

<< >>
<< >>

SECTION 005213.11 - AGREEMENT FORM - AIA STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 SUMMARY

A. Document Includes:

1. Agreement.

B. Related Documents:

1. Document 007213.11 - General Conditions - AIA Stipulated Sum (Single-Prime Contract).
2. Document 007313 - Supplementary Conditions - AIA.

1.2 AGREEMENT

- A. Basis of Agreement between Owner and Contractor: AIA A101 - Standard Form of Agreement between Owner and Contractor where the basis of payment is a Stipulated Sum.

END OF DOCUMENT 005213.11

DRAFT 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)

Niagara University
11 Vincentian Drive, P.O. Box 2033
Niagara University, New York 14109

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

« »

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

Academic Innovation Center- Work Force Development Training
822 Cleveland Avenue
Niagara Falls, New York 14305

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

LaBella Associates
300 Pearl Street, Suite 130
Buffalo, New York 14202

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.

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), the Contract Bid Documents, 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. In interpreting the Contract Documents, the Agreement and the General Conditions shall take priority over any supplemental or other conditions, drawings, specifications and other Contract Documents, unless expressly stated to the contrary in those other documents.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents for all construction of [Project Location and Title], including architectural, mechanical, electrical and sitework made necessary by the construction activity. The work to be done under the contract and in accordance with the Contract Documents consists of performing, installing, furnishing and supplying all equipment, labor and incidentals necessary, as well as all duties and obligations imposed upon the Contractor, 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.)

« The Work to be performed under this Agreement shall commence immediately upon receipt of the fully executed Contract.»

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. The Contractor acknowledges that time is of the essence for this Project.

§ 3.3 Substantial Completion

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

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

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

[] By the following date: Listed as a part of the Milestone Schedule

§ 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
Addition structure, completed roof and exterior wall systems	Listed as a part of the Milestone Schedule

§ 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.

§ 3.4 Scheduled Completion Dates. Within () days of the date of the award of this Contract, the Contractor shall submit for the review of the Owner and the Architect a schedule ("Completion Date Schedule") that sets forth the rate of progress and practical order of the Work, including the scope of Work included in each such portion and also including the dates for starting and completing each portion of the Work, (each such completion date is a "Scheduled Completion Date"). Subject to delays and extensions of time as set forth in §8.3 of the General Conditions, Contractor shall complete each portion of the Work by the applicable Scheduled Completion Date, as set forth on the Completion Date Schedule.

§ 3.5 Monthly Narrative Reports. In addition to all other reports required to be provided by the Contractor pursuant to the Construction Documents, the Contractor shall provide to the Owner and the Architect monthly narrative reports which shall include (i) a description of the current and anticipated problem areas, delaying factors, and their impact, (ii) an explanation of corrective action taken or proposed, and (iii) if the Project is not in compliance with the dates provided in the Completion Date Schedule, an explanation of what measures will be taken in the next thirty (30) days to put the Work back on schedule and in compliance with the Completion Date Schedule.

§ 3.6 The Contractor shall achieve final completion of the entire work no later than _____ . This shall include all punch list work and demobilization off-site.

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. The Contract Sum includes all expenses necessary to complete the Work and has taken into account all foreseeable factors, including but not limited to increased prices and delay.

§ 4.2 Alternates

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

Item	Price
Base Bid:	\$
Alternates (Add/Deduct):	\$
TOTAL CONTRACT SUM:	\$

§ 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
NOT APPLICABLE	INCLUDE ALLOWANCES IF REQUIRED

§ 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)
NOT APPLICABLE		

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

« NOT APPLICABLE »

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

« NOT APPLICABLE »

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.

« »

§ 5.1.3 The Owner shall make payment of the amount certified to the Contractor within thirty (30) days after the Application for Payment is received by the Architect and approved by the Owner.
(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.)

«Ten Percent (10%) Retainage »

§ 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.)

« NOT APPLICABLE »

§ 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.)

« NOT APPLICABLE »

§ 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.)

« NOT APPLICABLE »

§ 5.1.8 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, and:

« Complete submission and acceptance by the Owner of all Project close-out documentation – O & M Manuals, As-Built Drawings, warranties and all other close-out documents, including but not limited to final waivers of lien and claim received by the Owner prior to the release of payment. The Owner shall also have received to its satisfaction the completion of all required testing of any and all equipment and building systems called for in the Contract with the Contractor or any of its subcontractors or suppliers. »

§ 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.)

« » % « NOT APPLICABLE »

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.

« »

§ 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 located in Niagara County, New York

[] 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.)

« Section 14.4.3 of AIA A-201 – 2017. »

§ 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 or as may have been amended by mutual agreement of the parties hereto.

§ 8.2 The Owner's representative:

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

«Dan McMann »
«Niagara University»

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

« TO BE COMPLETED »

§ 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:

« For change order work performed by a subcontractor pursuant to a Change Order issued under this clause, each subcontractor shall be paid (i) one hundred percent (100%) of its actual work costs (labor and materials) as allowed under Cost of the Work, plus (ii) no more than ten percent (10%) of the total of its work costs specified in (i) above as its overhead and profit. In the event tiered subcontractor work is required, in no instance shall the combined tiered subcontractor and subcontractor mark-up exceed twenty percent (20%) of the actual work costs. »

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 Exhibit A Niagara University Insurance Requirements for Contractors
- .3 AIA Document A201™ -2017, Exhibit B, 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
Niagara University Contract Documents (Project Title) prepared by (Architect) attached hereto		

.6 Specifications

Section	Title	Date	Pages
Niagara University Contract Documents (Project Title) prepared by (Architect) attached hereto			

.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.)

[] 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
NOT APPLICABLE			

.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.)

« Contractor’s Bid Proposal Dated: _____
 List of Contractor Reductions Dated: _____
 Contractor’s Revised Proposal Dated: _____
 All Change Orders: _____
 »

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

NIAGARA UNIVERSITY

OWNER (Signature)

« »« »

(Printed name and title)

CONTRACTOR (Signature)

« »« »

(Printed name and title)

REQUEST FOR INFORMATION

DATE:

PROJECT #: 2221723		
<i>RFI #</i>	<i>Contract #</i>	<i>Rev.#</i>

Project Information:

OWNER: Niagara University 11 Vincentian Drive, P.O. Box 2033 Niagara Falls, NY 14109	ARCHITECT: LaBella Associates, D.P.C. 300 Pearl Street, Suite 130 Buffalo, NY 14202	CONTRACTOR:
--	---	------------------------

RFI Information:

RFI TITLE:	CONTRACTOR RFI #:	DISCIPLINE:

QUESTION / REQUEST:
Signed: _____ Dated: _____

SUGGESTED SOLUTION:
Signed: _____ Dated: _____

ARCHITECT / ENGINEER RESPONSE:
Signed: _____ Dated: _____

DOCUMENT 006113 – PERFORMANCE BOND

1.1 PERFORMANCE BOND

A. AIA Document A312, "Performance Bond," is hereby incorporated into the Procurement and Contracting Requirements by reference.

1. A copy of AIA Document A312, "Performance Bond," is bound in this Project Manual.

END OF DOCUMENT 006113

DRAFT AIA® Document A312® - 2010

Performance Bond

CONTRACTOR:
(Name, legal status and address)

« »
« »

SURETY:
(Name, legal status and principal
place of business)

« »
« »

OWNER:
(Name, legal status and address)

Niagara University
11 Vincentian Drive, P.O. Box 2033
Niagara University, New York 14109

CONSTRUCTION CONTRACT

Date: « »

Amount: \$ «0.00»

Description:

(Name and location)

Academic Innovation Hub – Work Force Development Training
822 Cleveland Avenue
Niagara Falls, New York 14305

BOND

Date:

(Not earlier than Construction Contract Date)

« »

Amount: \$ « »

Modifications to this
Bond:

None

See Section 16

CONTRACTOR AS PRINCIPAL
Company: (Corporate Seal)

Signature: _____
Name and « »
Title:

SURETY
Company: (Corporate Seal)

Signature: _____
Name and « »
Title:

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

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:

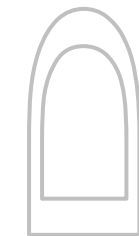
(Architect, Engineer or other party:)

LaBella Associates DPC
300 Pearl Street, Suite 130
Buffalo, New York 14202

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

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

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



ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

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

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

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

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

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

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

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

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

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

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

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

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

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to

the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

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

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

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

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

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

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

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

§ 14 Definitions

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

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

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

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

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

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

§ 16 Modifications to this bond are as follows:

<< >>

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

CONTRACTOR AS PRINCIPAL

Company:

(Corporate Seal)

Signature:

Name and Title:

Address:

<< >><< >>

<< >>

SURETY

Company:

(Corporate Seal)

Signature:

Name and Title:

Address:

<< >><< >>

<< >>



DRAFT AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

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

Academic Innovation Center- Work Force Development Training
822 Cleveland Avenue
Niagara Falls, New York 14305

THE OWNER:
(Name, legal status and address)

Niagara University
11 Vincentian Drive, P.O. Box 2033
Niagara University, New York 14109

THE ARCHITECT:
(Name, legal status and address)

LaBella Associates
300 Pearl Street, Suite 130
Buffalo, New York 14202

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- 3 CONTRACTOR
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- 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
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- 9 PAYMENTS AND COMPLETION
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- 12 UNCOVERING AND CORRECTION OF WORK
- 13 MISCELLANEOUS PROVISIONS

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

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

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

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- 14 TERMINATION OR SUSPENSION OF THE CONTRACT
- 15 CLAIMS AND DISPUTES



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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract (See AIA A101 9.9). 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. In interpreting the Contract Documents, the Agreement and these General Conditions shall take priority over any supplementary or other conditions, drawings, specifications and other Contract Documents, unless expressly stated to the contrary in those other documents. To the extent that any conflict between the drawings and specifications exists, the drawings shall control.

§ 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 of the Contractor 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. The drawings shall be considered primary and shall control over the specifications in the event of any conflict between the documents.

§ 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.

§ 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 may retain one record set of the Instruments of Service. All copies, except the Contractor's record set, shall be returned or suitably accounted for to the Architect upon the completion of the Work. 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.

§ 1.5.3 Nothing in this Section 1.5 shall be construed to alter the rights of the Owner toward the drawings, specifications or other documents prepared by the Architect and the Architect's Consultants as set forth in this Agreement between the Owner and the Architect.

§ 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 as a guide, to establish the protocols for the development, use, transmission, and exchange of digital data for the Project.

§ 1.8 Building Information Models Use and Reliance

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

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 [INTENTIONALLY OMITTED].

§ 2.2.2 [INTENTIONALLY OMITTED].

§ 2.2.3 [INTENTIONALLY OMITTED].

§ 2.2.4 [INTENTIONALLY OMITTED].

§ 2.3 Information and Services Required of the Owner

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

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

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

§ 2.3.4 [INTENTIONALLY OMITTED].

§ 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 period of four (4) business days 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. The Owner shall be entitled to recover its costs in correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. In such a case, the Owner shall issue an appropriate Change Order deducting from payments then or thereafter due to the Contractor the reasonable cost of correcting such deficiencies. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner on demand. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly, to be defined as immediately but in no event longer than three (3) business days, report to the Owner and Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Owner and 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, to be defined as immediately but in no event longer than three (3) business days, report to the Owner and Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Owner and 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 and shall complete the Work in a good and workmanlike manner in accordance with the Contract Documents. 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.

§ 3.3.4 If any of the Work is required to be inspected or approved by any public authority, or if any inspection of the Work is required by the Contract Documents, the Contractor shall cause such inspection or approval to be performed. No inspection performed or failed to be performed hereunder shall be a waiver of any of the Contractor's obligations hereunder or be construed as an approval or acceptance of the Work or any part thereof.

§ 3.3.5 The Contractor acknowledges that it is the Contractor's responsibility to hire all personnel for the proper and diligent prosecution of the work and the Contractor shall use the Contractor's best efforts to maintain labor peace for the duration of the Project.

§ 3.4 Labor and Materials

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

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

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees, subcontractors and their agents and employees, and other persons performing Work under the Contract for the Contractor, 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. The Contractor shall be responsible for providing all necessary warranty documentation to the Owner.

§ 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. The Owner represents that it is an organization operated for purposes which make it exempt from New York State sales and compensating use tax under Article 28 of the New York Tax Law. The Contractor is further advised that the Owner is exempt from payment of all state and local sales and compensating use taxes of the State of New York and its cities and counties and the Contractor's purchase of materials and supplies which are to be incorporated in and become integral component parts of the Owner's structures, buildings or real property, pursuant to the provisions of this Contract. Such taxes are not to be added to the Contract sum, bid or costs to be reimbursed, as the case may be. This exemption does not, however, apply to tools, machinery, equipment or other property leased by or to the Contractor or a subcontractor, or to supplies and materials which, even though they are consumed in the performance of this Contract, are not incorporated into the Owner's structures, buildings or real property. The Contractor and its subcontractors shall be responsible for and shall pay any and all applicable taxes, including sales and compensating use taxes, on such leased tools, machinery, equipment or other property and on all such unincorporated supplies and materials. The Owner shall deliver to the Contractor the appropriate exemption certificate to be supplied by the Owner, and the Contractor, its subcontractors and materialmen shall be solely responsible for obtaining and delivering any and all exemption certificates or for furnishing a contractor exempt purchase certificate or other appropriate certificates to all persons, firms or corporations from whom the Contractor purchases supplies, materials and equipment for the performance of the Work covered by this Contract.

§ 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. The Contractor shall also procure all certificates of inspection, use, occupancy, other permits and licenses pursuant to the Work of the Contract, pay all charges and fees and give all notices necessary and incidental to the due and lawful prosecution of the Work. Certificates of inspection, use and occupancy shall be delivered to the Owner upon completion of the Work in sufficient time for occupancy of the Project in accordance with the approved schedule for the Work. The costs of such procurement, payment and delivery are included within the Guaranteed Maximum Price or Lump Sum as may be applicable.

§ 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 three (3) business days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

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

§ 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. The Contractor's Superintendent or responsible temporary substitute shall attend all job meetings.

§ 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 and the Owner's approval a Contractor's construction schedule for the Work. The schedule must include Owner identified action dates identifying when specific action is required of the Owner in conjunction with the Contractor's schedule. 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 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 in sufficient detail to enable the Architect to prepare reproducible record drawings of the Project as built, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

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

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

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

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

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal

schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

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

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

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

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

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

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

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

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment. The Contractor shall assure free, convenient, unencumbered and direct access to properties neighboring the Project site for the owners of such properties and their respective tenants, agents, invitees and guests.

§ 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, or as specified by the Owner, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project. Except as may be expressly specified to the contrary in the Contract elsewhere, the Contractor shall clean all glass windows and surfaces so that they are dust-free upon the completion of the Work and shall leave the site "broom-clean" or its equivalent.

§ 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 with qualified and competent counsel 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 Owner and Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall defend with qualified and competent counsel and 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 and disbursements, 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 (including any liability, claim, damage, loss or expense incurred under any workers' compensation law or regulation), 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 or other culpable conduct 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. The Contractor shall also indemnify and hold harmless the Owner against any and all claims for mechanics' liens by subcontractors, sub-subcontractors or material suppliers and against any security interests by suppliers of goods or materials. 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 communicate with each other directly or through the Architect. 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.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and the Owner will then 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 or Contractor at the Owner's discretion 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 interpretations or decisions rendered in accordance with the Contract Documents and in the exercise of professional care.

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

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

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

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

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

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

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of

receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

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

§ 5.2.3 [INTENTIONALLY OMITTED].

§ 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. Immediate advance notice of a proposed substitution shall be provided by the Contractor to the Owner.

§ 5.3 Subcontractual Relations

§ 5.3.1 By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work 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.

§ 5.3.2 The Contractor shall not enter into any subcontract, contract, agreement, purchase order or other arrangement ("Arrangement") for the furnishing of any portion of the materials, services, equipment or work with any party or entity if such party or entity is an affiliated entity (as defined below), unless approved by the Owner after full disclosure. The term "affiliated entity" means any entity related to or affiliated with the Contractor or with respect to which the Contractor has a direct or indirect ownership or control, including without limitation any entity owned, in whole or in part, by the Contractor, any holder of more than 10% of the issued and outstanding shares of, or the holder of any interest in, the Contractor, any entity in which any officer, director, employee, partner or shareholder (or member of the family of any of the foregoing persons) of the Contractor or any entity owned by the Contractor as a direct or indirect interest, which interest includes but is not limited to that of a partner, employee, agent or shareholder.

§ 5.4 Contingent Assignment of Subcontracts

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

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

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

§ 5.4.2 [INTENTIONALLY OMITTED].

§ 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 Owner will perform Work related to the Project with the Owner's own forces and will award contracts in connection with the Project which are not part of the Contractor's responsibilities under this Agreement. The Contractor will be responsible for the coordination and integration of work to be performed by the Owner's forces and separate contractors within the Contractor's schedule. The Contractor shall manage its work to ensure that it is not interrupted or delayed on account of the awarding of other work on the Project to other contractors.

§ 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 cooperate with the Contractor 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 make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

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

§ 6.2 Mutual Responsibility

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

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

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

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

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

§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Changes in the Work may be initiated by the Contractor's issuance of (and the Owner's and the Architect's written approval of) a written Change Order Proposal which describes the change in the Work and the estimated cost of the change. Upon written approval by the Owner and the Architect of a Change Order Proposal, the Contractor may proceed with such changed Work pending the issuance of a formal Change Order document.

§ 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 Owner and signed by the Owner's comptroller, the Contractor, and the Architect stating their agreement upon all of the following:

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

§ 7.3 Construction Change Directives

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

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

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

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

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

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

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

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

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

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

§ 7.3.8.1 Unless otherwise stated in the Agreement, the maximum allowance for a combination of overhead and profit for work shall be as follows: (a) when such added work is performed by the Contractor's own forces, ten percent (10%) of the costs attributable to the change; and (b) when such added work is performed by a subcontractor or sub-subcontractor whose price is passed on to the Contractor, ten percent (10%) of the costs to the subcontractor or sub-subcontractor attributable to the change and ten percent (10%) of the amount billed to the Contractor by such subcontractor or sub-subcontractor.

§ 7.3.9

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

§ 7.4 Minor Changes in the Work

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

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.1.5 The date of final completion of the Work shall be the date on which the Contractor has finally completed satisfactorily all the Work required of the Contractor under and in accordance with the Contract Documents, including all close-out documents identified in Section 9.10.2.1.

§ 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; or (4) unavoidable casualties documented in accordance with Section 15.1.6.2 or other causes beyond the Contractor’s control; by delay authorized by the Owner, or 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. A copy of any claim for extension of Contract time shall be delivered to the Owner and the Contractor shall immediately take all steps reasonably possible to lessen the adverse impact of such delay on the Owner.

§ 8.3.3 The Contractor agrees to make no claim for damages for delay in the performance of the work under this Agreement caused by any act or omission to act of the Owner or any of its representatives, architects or contractors with respect to this Project and agrees that it shall be fully compensated for any delay by an extension of time to complete the performance of the Work.

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 fifteen (15) days before the date established for each progress payment, the Contractor shall submit to the Owner and 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, provided that these are included in fully executed Change Orders timely issued by the Owner and signed by all parties, which shall include all undisputed amounts to be paid.

§ 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. The Contractor further warrants that, except as the Contractor specifically notifies the Owner in writing, no Work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor, or by any other person performing Work at the site or furnishing materials and equipment for the Project, subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor on such other person.

§ 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. The Owner shall not be bound by the Architect's Certificate for Payment. The Owner may make its own investigation of the progress of the Contractor's Work and shall be obligated to pay only for Work actually completed by the Contractor in accordance with the Contract Documents.

§ 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;
- .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. The Contractor shall place in effect for every Payment Application the issuance of the AIA G706 – 1994 Contractor's Affidavit of Payment of Debts and Claims, if applicable, and G706-A – 1994 Contractor's Affidavit of Release of Liens, or forms submitted by the Owner to that effect, from every contractor, subcontractor and sub-subcontractor, including material suppliers, to the Owner with each Payment Application submitted.

§ 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.

§ 9.6.4.1 The Contractor shall take prompt action with respect to any lien filed or claim made by any of its suppliers, materialmen, subcontractors, sub-subcontractors, or others to whom it is obligated so that any such liens or claims will be removed of record as against the Owner or the Owner's property within sixty (60) days after they are filed or made. To the extent such liens and claims are caused by the acts or omissions of the Contractor, the Contractor shall be solely responsible for the removal and payment of all such liens and claims, and the Owner shall have no liability with respect to them. If the Contractor does not promptly remove any such lien or claim as required by this Section, the Owner may withhold as a security a sum equal to one and one-half (1.5) times the amount of the lien or claim from payments otherwise due to the Contractor, until the lien or claim is removed or paid. As is further set forth in Section 3.18.1 of this Agreement, the Contractor must indemnify the Owner in this regard.

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

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

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

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

§ 9.7 Failure of Payment

If the Owner does not pay the Contractor within thirty (30) days after the date established in the Contract Documents for resolution of disputes of the amount accordingly due, then the Contractor may, upon seven (7) additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

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

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

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not

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

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

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

§ 9.9 Partial Occupancy or Use

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

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

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

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. The Owner shall not be bound by the Architect's final Certification for Payment. The Owner may make its own investigation of the progress of the Contractor's Work and shall be obligated to pay for only the Work actually completed by the Contractor in accordance with the Contract Documents.

§ 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.

§ 9.10.2.1 Final completion of the work shall be further conditioned upon satisfaction of the following minimum criteria:

1. all Work shown and described in the Contract Documents is complete, including all punch list items; Record As-Built Drawings and documentation has been submitted and approved by the Owner;
2. operations and maintenance manuals for all products and equipment, as required, have been submitted and approved by the Owner;
3. equipment or product testing required by the Contract Documents or by regulatory agencies have been completed, submitted and approved (and recorded in O&M Manuals);
4. all required Owner training has been completed and documented;
5. all regulatory agency certifications have been submitted or received by the Owner; and
6. all areas have been cleaned pursuant to the terms herein.

§ 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

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

§ 10.1.2 Prior to the commencement of any Work, the Contractor shall develop and maintain a Safety Program specifically designed for the contracted scope of work. The Contractor shall be responsible for all safety within the Contract limit line from the start of construction through final completion. It shall ensure that all personnel, subcontractors, suppliers, Owner's representatives and visitors adhere to the rules and regulations referred to and established by its Safety Programs.

§ 10.1.3 The Contractor's Safety Program shall contain but is not necessarily limited to the following:

1. reference to all safety-related rules, codes, regulations, OSHA standards, etc.;
2. a designated safety officer in accordance with Section 10.2.6 with required responsibilities;
3. means and methods for maintenance of the Safety Program at the Project site;
4. requirements for all subcontractors to supply and maintain Safety Programs;
5. requirements for all subcontractors to adhere to the Contractor's Safety Program;
6. regular safety inspections with formal distribution and filing of reports;
7. a continuing on-site education program of all personnel by means of formal classes and/or "Tool Box" meetings; and
8. procedures to ensure that safety-related items are included in the agendas of all regularly scheduled Project-related meetings.

§ 10.1.4 The Contractor shall require all personnel, including those of the subcontractors, sub-subcontractors and suppliers, to report any accidents at the time of the incident. The Contractor shall notify the Owner in writing within twenty-four (24) hours after it becomes aware of an incident and shall conduct a full investigation of any accident with the formal distribution and filing of a written report in a timely manner.

§ 10.1.5 The Owner reserves the right to comment, correct or add to the Contractor's Safety Program. The Contractor shall immediately implement such changes to the Safety Program.

§ 10.1.6 The Owner may at any time and without notice to the Contractor make its own safety observations. The Contractor shall cooperate in any way necessary to facilitate such observations and will immediately implement the necessary means and methods to mediate any problems or hazards transmitted to it either verbally or in writing.

§ 10.2 Safety of Persons and Property

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

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

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

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards. The Contractor shall protect adjoining private or municipal property and shall provide barricades and temporary fences and covered walkways required to protect the safety of passers-by as required by prudent construction practices, local building codes, ordinances or the Contract Documents.

§ 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 The Contractor shall maintain Work, materials and apparatus free from injury or damage from rain, wind, storms, frost or heat. If adverse weather makes it impossible to continue operation safely in spite of weather precautions, the Contractor shall cease work and notify the Owner and the Architect of such cessation. The Contractor shall not permit open fires on the project site.

§ 10.2.9 In addition to its other obligations pursuant to this Article 10, the Contractor shall, at its sole cost and expense, promptly repair any damage or disturbance to walls, utilities, sidewalks, curbs and the property of third parties (including municipalities) resulting from the performance of the Work whether by it or by its subcontractors at any tier.

§ 10.2.10 The performance of the foregoing services by the Contractor shall not relieve the subcontractors of their responsibilities for the safety of persons and property and for compliance with all federal, state and local statutes, rules, regulations and orders of any governmental authority applicable to the conduct of Work.

§ 10.2.11 Injury or Damage to Person or Property

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

§ 10.3 Hazardous Materials and Substances

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

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

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

(other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

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

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

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

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in Exhibit A of A101-2017 Standard Form Agreement Between Owner and Contractor.

§ 11.1.2 INTENTIONALLY OMITTED.

§ 11.1.3 INTENTIONALLY OMITTED.

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

§ 11.2 Owner's Insurance

§ 11.2.1 **Liability Insurance.** The Owner shall be responsible for purchasing and maintaining the Owner's usual general liability insurance.

§11.2.2 Property Insurance. Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk, completed value, special perils or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising the total value for the entire Project at the site on a replacement cost basis. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.2.2 to be covered, whichever is later. This insurance shall designate the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project as Named Insureds or otherwise include the interests of the Owner, Contractor, Subcontractor and Sub-subcontractors in the Project.

§11.2.2.1 Property insurance shall be on a special perils or equivalent policy form and shall include insurance

against the perils of fire with extended coverage and physical loss or damage, including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, windstorm (and, at the option of Owner, earthquake, flood and/or terrorism), falsework, testing and startup, temporary buildings and debris removal, and shall not exclude reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss. Property insurance provided by the Owner shall not cover any tools, apparatus, machinery, scaffolding, hoists, forms, staging, shoring and other similar items commonly referred to as construction equipment that may be on site and the capital value of which is not included in the Work. The Contractor shall purchase and maintain insurance on such construction equipment in accordance with Exhibit A of A101™-2017, Standard Form of Agreement Between Owner and Contractor.

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

§11.2.2.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles unless the loss or damage is caused by the Contractor, in which case the Contractor shall pay the deductible.

§11.2.2.4 This property insurance shall cover portions of the work stored off the site, and also portions of the work in transit contingent upon the Contractor, prior to the commencement of Work, providing written notice to the Owner of the property insurance policy limits needed to adequately protect property stored off the site and property in transit.

§11.2.2.5 If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain property insurance, written on a "special perils" or equivalent basis, on a replacement cost basis, protecting the existing structure against direct physical loss or damage, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

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

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

§11.2.4 Loss of Use Insurance. The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused.

§11.2.5 Notice of Cancellation or Lapse of Owner's Required Property and Boiler and Machinery Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or lapse of any property or boiler and machinery insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or lapse. 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 lapsed 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. This waiver, however, shall not apply to property insurance purchased by Owner after completion of the work or Final Payment, whichever comes first. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, the 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.[INTENTIONALLY OMITTED].

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance
[INTENTIONALLY OMITTED].

§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 in good faith and made payable to the Owner in good faith for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in a 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.

§ 11.6 Performance and Payment Bonds

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

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

§ 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 and enforced under the laws of the State of New York.

§ 13.2 Successors and Assigns

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

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

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

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

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

§ 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

[INTENTIONALLY OMITTED].

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; or
- .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.

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

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

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

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

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

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

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and

- 3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

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

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

§ 14.3 Suspension by the Owner for Convenience

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

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

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

§ 14.4 Termination by the Owner for Convenience

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

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

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

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

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

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

§ 15.1.2 Time Limits on Claims

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

§ 15.1.3 Notice of Claims

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

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

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

§ 15.1.5 Claims for Additional Cost

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

§ 15.1.6 Claims for Additional Time

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

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

§ 15.1.7 Waiver of Claims for Consequential Damages [INTENTIONALLY OMITTED].

§ 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 thirty (30) days from the date of receipt of an initial decision file for mediation.

§ 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, meaning litigation, 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 thirty (30) days from the date that mediation has been concluded without resolution of the dispute or sixty (60) days after mediation has been demanded without resolution of the dispute, proceed to litigation if appropriate.

§ 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 [INTENTIONALLY OMITTED].

§ 15.4.4 Consolidation or Joinder [INTENTIONALLY OMITTED].

SPECIAL PROVISIONS

SPECIAL PROVISIONS for ALL CONTRACTORS

NIAGARA UNIVERSITY
Academic Innovation Hub
Work Force Development Center
822 Cleveland Avenue, Niagara Falls, NY 14305

DATE: March 3, 2024

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1.0 DEFINITIONS

- 1.1 The terms “Prime Contractor”, “Contractor” or “Subcontractor” shall mean the entity, which has contracted to perform a portion of the work; the successful bidder to whom the contract has been awarded from the Owner.
- 1.2 The term “sub-subcontractor” or “sub-tiers” shall mean anyone hired by a subcontractor to furnish labor or material to perform a portion(s) of their contracted work. Sub-subcontractors do not hold direct contracts with the Owner.
- 1.3 “Furnish” – Purchase and deliver to the project site complete with every necessary accessory and support, as well as any surcharges as may be required to assure that purchased items are free of all liens, claims or encumbrances.
- 1.4 “Install” – Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the work.
- 1.5 “Provide” – Furnish and install.
- 1.6 “Contract Documents” shall mean and include the executed contract agreement with the Owner, together with all documents referred to therein; the plans, specifications, drawings, and all clarifications, modifications, and addenda issued before or after the contract is executed. Additionally any released and approved change orders shall become part of the Contract Documents.

2.0 GENERAL PROJECT DESCRIPTION & NARRATIVE

2.1 Project Description and Narrative

The existing building (formerly the First Congregational Church) was constructed in 1885 with a subsequent addition constructed in the 1923. This building is historically significant with the Niagara Falls Historic Preservation Commission and the State Historic Preservation Office (SHPO). All work shall comply with the Secretary of the Interior’s Standards for the Treatment of Historic Properties (36 CFR Part 68, 1995). The proposed work includes both exterior and interior rehabilitation for general construction, mechanical, electrical, plumbing and fire protection. Majority of the work will occur in the lower level (basement), rear of main floor and exterior. The existing main floor “former sanctuary space” will remain as is unless indicated per the drawings.

The project is grant funded by Empire State Development (ESD), U.S Department of Housing and Urban Development (HUD) and Economic Development Agency (EDA) and will need to meet all state and federal requirements outlined for the project.

The project site: 822 Cleveland Avenue, Niagara Falls, New York 14305.

The Project name: Academic Innovation Hub- Work Force Development Center

The Project Organization will be as follows:

OWNER:

Niagara University

11 Vincentian Drive, Unit #2033
Niagara University, New York 14109

Contact –

Daniel McMann, Director of Facility Services, (716) 286-8755 or dmcmann@niagara.edu
Keith Sargent, Campus Superintendent (716) 286-8441 or ksargent@niagara.edu

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ARCHITECT/ENGINEER:

LaBella Associates
300 Pearl Street, Suite 130
Buffalo, New York 14202

Contact-

Joe Rudniski- Project Manager, (716) 931-6510 or JRudniski@labellapc.com

2.2 Conflict of Documents

These Special Provisions are in addition to the plans and specifications and other contract documents prepared by Labella Associates or others and shall be a part of this Agreement.

2.3 General Requirements

- A.) The Contractor warrants that prior to submission of their lump sum proposal, they have visited the site for the purpose of fully understanding and accepting all conditions in and around the construction site.
- B.) It is recognized and understood that the contractor, who possess certain skills, knowledge, experience, training and sound judgment as well as a particular knowledge of techniques, procedures, systems and the state of the art of their specialty, is expected to include in the scope of work and/or systems, all items required to perform the work shown on the Contract Documents or reasonably inferable.
- C.) Any direct labor cost or Contractor cost incurred by the Architect/Engineer, or the Owner due to lack of performance by a Contractor shall be charged back to the non-performing Contractor and billed at a rate equal to the regular or premium time wages of the trades(s) employed or subcontracted with marked-up costs plus an additional 15% added for administrative overhead.
- D.) Considering the Contractor's skills, knowledge, experience, training and sound judgment as well as particular knowledge in the state of the art of their specialty, it shall be their responsibility upon discovery, to immediately notify Owner, in writing, of errors, omissions, discrepancies and noncompliance with applicable codes and regulations within the documents or any work which will not fit or properly function if installed as indicated in the contract documents. This item is in no way intended to relieve the Architects and/or Engineers of their design responsibility. It is also understood that the Contractor "must" take special care in reviewing the drawings and specifications for all requirements necessary for the issuance of a Certificate of Occupancy concerning the Contractor's scope of work.
- E.) It is understood that the firm lump sum proposal submitted shall be in strict accordance with plans, specification and other contract documents. Substitutions will not be allowed unless specifically outlined in the proposal accompanied by all pertinent data and corresponding dollar value adjustment and accepted by the Architect / Engineer and Owner.
- F.) The lump sum price shall be firm for the life of the project and includes all escalating expenses.
- G.) All work shall comply with all applicable laws, codes and regulations, including those of OSHA, New York State, County of Niagara, and Town of Lewiston, NY. The Contractor is charged with full notice and knowledge of all requirements contained therein and shall execute their work in full compliance within the terms and conditions of the contract.

2.4 Construction / Change Documents

- A.) The Architect will issue to the Contractor five (5) sets of prints of the Contract Drawings and Specifications related to this work at the start of their contract. The Architect will also issue the same number of any revised documents during the performance of this contract that

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may affect the scope of original contract work. The Contractor shall be responsible for reproducing prints and specifications for their own use, including any subcontractors and vendors used for the purpose of executing their contract work.

- B.) The Architect will periodically issue Bulletins, Field Reports, Request for Information responses, etc.; each Contractor will be responsible to insure that their personnel are working from the most current release of documents.

3.0 INFORMATION REQUIRED BEFORE STARTING WORK/GENERAL REQUIREMENTS

3.1 Detailed Work Plan

Within ten (10) days after notice to proceed the successful Contractor shall submit a detailed work plan outlining all phases of their work and their subcontractors work to the Owner. At a minimum, this written plan must include:

- A) A Site Specific Logistics Plan that describes, in detail, the methods that will be used to perform the scope of work. The plan must identify major equipment that will be used, any temporary utilities that will be required to perform your work, and how materials will be brought on-site and into the building and/or how debris will be removed from the site.

In addition, the selected contractor in collaboration with Niagara University may seek prior approval from the City of Niagara Falls Council to use a portion of the existing adjacent surface grade parking lot for construction trailers, material storage, staging, etc... Included in the bid package is a conceptual diagram for bidding coordination.

- B) A Project Schedule aligned with the Project Summary schedule outlining and detailing all phases of the work that clearly identifies sequence of work, manpower requirements, duration to complete each major work area and activity, critical starting dates, long lead item approval/release, delivery dates and expected shift work. As work progresses, updated 1-week look-ahead schedules must be provided to coincide with project meeting dates. The 1-week look ahead schedules must be submitted at a minimum of 24 hours prior to the scheduled progress meeting. In addition, a shop drawing submission schedule must be provided within ten working days of notice to proceed showing all items requiring shop drawings and/or catalog cuts. This schedule must specify the estimated dates of submission, fabrication times, and the delivery dates required to maintain the Project Schedule.
- C) A project specific Staffing Plan that identifies who will manage the overall scope of your work for this project. This plan must identify (by name, title and contact information- emails/ phone numbers) the individual staff members you will use on the site. Additionally, the work experience resumes of the listed individuals must be submitted. The Contractor shall provide supervisory personnel consistent with the size and complexity of the project, who shall be fully capable of controlling their workers, coordinating, and completing work in accordance with the project schedule.
- D) The Contractor shall furnish a list of Sub-contractors, Sub-subcontractors, Suppliers, and Vendors for Owner review and approval, which they propose to use on the Project and shall notify the Owner of any changes.
- E) The work shall include the obligation of any Contractor who bids to perform any portion of the work to visit the site of the proposed work, fully acquaint and familiarize itself with the conditions as they exist and the character of the operations to be carried on under the proposed contract, and make such investigation as it may see fit so that it shall fully understand the facilities, physical conditions and restrictions attending the work under the Contract. Each such Contractor shall also thoroughly examine and become familiar with the Drawings, Specifications and ALL associated Bid Documents.

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3.2 Safety Procedures Manual

Prior to beginning any work on site, each Contractor shall submit an OSHA compliant **Site Specific Safety Procedures Manual** that identifies all site-specific safety issues related to his work and details how each will be addressed. This manual will include the **Material Safety Data Sheets** (MSDS) for all potentially hazardous substances that will be used in performing the scope of your work. In addition, a **Site Specific Hazardous Substance Survey Form** that outlines all of the MSDS sheets applicable to this project must be submitted. MSDS inventory logs shall be updated each week for the duration of the project.

3.3 Schedule of Values

A) No more than (10) calendar days after Notice to Proceed, The Contractor will submit to the Owner a detailed schedule of values, which will be used as the basis for monthly requisitions. This schedule must be submitted on the appropriate AIA Form G-702 and G-703. To speed-up the invoicing process, the schedule of values must be detailed and broken down to a level of detail that may be easily reviewed each month (i.e. by work category, by area, by floor, by materials, etc.). Each line item shall be broken into labor and material. Include a general conditions line which will be billed by a % each month based on current project completion. In addition, please incorporate the following items as separate breakout items:

1. Hold 10% for retainage
2. Hold 2% for submittals
3. Hold 1% for closeout
4. Hold 2% for safety and site cleanup

B) Compensation for compliance with safety and cleanup rule shall be in equal monthly payments. Failure to comply and meet the requirements will result in the loss of that month's payment. A deduct change order will then be issued.

C) The schedule of values shall indicate the separation of the scope of work as outlined in the bid documents:

- Non-EDA Scope of Work- funded by ESD (Empire State Development) and HUD (Community Project Funding)-) for core/shell and site
- EDA Scope of Work (Economic Development Agency)- interior tenant build out space (basement and 1st floor)

3.4 Crane Inspection Report

All Contractors whose work includes the use of material or personnel lifting devices must submit a copy of the **Annual Crane Inspection Report and a copy of the Operators Certification Card** prior to starting work. The report must conform to either OSHA section 1910.180 or section 1926.550. Note that this is not referring to a Crane Safety Checklist but rather the Annual Crane Inspection Report. If a crane is brought on site without proper documentation or inspection, said crane will be removed at once from the site, with any associated charges borne by the responsible Contractor.

3.5 Insurance Documents

A) The Contractor and any subcontractors or sub-subcontractors shall not begin work on site until a notice to proceed, an agreement that the AIA A101 contract will be signed, and proof and acceptance of insurance has been provided to Owner and approved by the Owner. With the sole exception of Worker's Compensation Insurance, **all insurances must name Niagara University as additional insured parties. Niagara University shall be named as the Certificate Holder.** Insurance limits shall be in accordance with the limits and details as specified and detailed in the General Conditions AIA A201.

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- B) If City owned parking lot is used for construction staging, material storage, etc...the City of Niagara Falls shall be listed as additionally insured for the parking area being used and for the duration of use until project is completed
- C) No work may continue and no payments to the Contractor will be made after the expiration date noted on the latest insurance certificate on file with Niagara University.
- D) All insurance policies shall not be cancelled or changed due to partial occupancy or until the expiration of at least thirty (30) days after written notice of such cancellation or change has been mailed to and received by Owner. Please see Article 11 of the AIA201document, including schedules A and B thereto.
- E) The Contractor shall assist and cooperate with Owner and the Owner and its insurance carrier(s) in connection with any claims relating to the project.

3.6 Pre-Installation/Start-up Conference

The Contractor shall arrange for a meeting on site with the AE and Owner prior to the scheduled start of work. This meeting will discuss the following items:

- A) Review progress of other activities and preparations for the activity under consideration, including schedules, safety, submittals, manufacturer's recommendations, weather limitations, substrate acceptability, compatibility problems, and specific inspection and testing requirements.
- B) Record significant discussions, agreements, and disagreements of each conference, along with the approved schedule. AE will distribute the meeting record to everyone concerned. The minutes will verify that the items listed above were discussed, will document the actions taken or required and by whom the action is required. The Contractor is required to review these minutes and submit any objections to AE within 3 days. Failure to respond within 3 days will constitute acceptance of the minutes.
- C) A list of contractor key personnel, with address and telephone numbers for emergency calls (both work hours and non-work hours).
- D) Contractor is expected to be experienced and familiar with the requirements and conditions imposed during the performance of similar work in this area. Some of these requirements are the performing of normal "out-of-sequence" work, and non-continuous work.
- E) The Contractors shall have responsible representations at job meetings held and scheduled by AE. Contractor failing to attend and abide by the content of these meetings may be held responsible for any delays and/or expenses incurred due to coordination difficulties in their trades.
- F) Before commencing any work, consult with Owner regarding the use of the facility, including but not limited to, roads, walks, ramps, garage, parking areas, storage areas, corridors, stairs, etc., that may be required to prosecute work.

3.7 Waiver of Liens

The Contractors, subcontractors, sub-subcontractors, and vendors shall submit AIA Partial Waiver of Liens with each and every pay application.

3.8 Communications

Any and all communication with the Architect/Engineer.

3.9 Conflicting Documents

If there is any conflict or variance between or among the Drawings and Specifications (including reference standards) the more stringent level or quality of performance shall control. Likewise,

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in the case of conflict between the General Conditions of the Contract or any modifications thereof and the detailed specification requirements (including reference standards) the more stringent level or quality of performance shall control. These Special Provisions are in addition to the plans and specifications and other contract documents prepared by Labella Associates.

3.10 Escalation

The lump sum price shall be firm for the life of the project and must include any and all escalating expenses or costs.

3.11 Wage Rates shall comply with Davis Bacon prevailing wage rate requirements as provided in the bid documents.

3.12 EEO

All Contractors, Subcontractors and Sub-subcontractors shall comply with all federal, state and local laws and regulations regarding equal employment opportunity- see bid documents

3.13 Preconstruction Photos and Preconstruction Video

A) The General Contractor shall contract with and provide an independent agency/company to perform a pre-construction damage survey (written and video) of all adjacent structures to remain, interior and exterior existing conditions, property lines, easements, roads, drainage ditches, walks, curbs, trees, plantings, and any other items that could be affected by this project's operations. The independent agency/company shall have previous experience in this type of survey/documentation. Submit four (4) copies of the completed damage survey to the Owner for approval and record upon completion.

B) The General Contractor shall also provide (2) copies of dated preconstruction photographs from a 35mm camera (can be digitally provided to owner), of the same items listed above, to the Owner prior to starting any work or mobilizing on site. Document all existing site conditions.

3.14.0 Taxes

New York State Sales Tax is not applicable. See A201 for specific details as it relates to taxes for the project.

4.0 SITE LOGISTICS

4.1 Site Access

A) The project site is located at 822 Cleveland Avenue, Niagara Falls, NY 14305. Site fencing will enclose the entire construction area. There will be lay down and short-term drop-off/unloading parking within the fenced area which will be strictly enforced.

B) The General Contractor shall provide, **MAINTAIN**, ultimately remove, and restore all site staging areas and construction access.

C) Daily sweeping/cleaning of all adjacent roads/parking lots around and leading to the project site shall be performed as required by the General Contractor to collect any loose debris (stone, dirt, mud, packaging, etc) that has been tracked or blown outside of the construction area.

D) Only the Owner has the authority to alter these site logistics for the overall benefit of the project. All contractors are to be aware of on going activities surrounding the construction zone and in some cases, within the construction zone. Access roads, exits and means of egress must be kept open and free from materials, equipment, vehicles and debris at all ti

4.2 Parking

Due to the logistics and staging of equipment and materials, there will be limited onsite parking for construction employees. Parking will be allowed on Cleveland Avenue. Additional off street

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parking may be available in adjacent city owned parking lot pending approval by City of Niagara Falls Council. Selected contractor shall work with Niagara University for any parking lot use submission to the Council prior to use.

4.3 Truck Routes

Contractor shall work with Owner to confirm any delivery restrictions with the City of Niagara Falls.

4.4 Deliveries

All Deliveries must be scheduled and coordinated with General Contractor AT LEAST 48-HOURS IN ADVANCE. Contractors must have one or more employees present (and all necessary equipment) at the time of delivery arrival, to receive, unload, and distribute materials. Unscheduled or out-of-sequence deliveries may be turned away.

4.5 Material and Equipment Storage/Staging

A) Construction materials and equipment deliveries must be scheduled with General Contractor. Contractors are to bring only that material which will be used in a reasonable time frame.

B) All equipment must be in compliance with all local, state, and federal regulations relating to its safety.

C) If in the opinion of the Owner, the jobsite cannot accommodate either early or bulk delivery of materials or equipment, the Contractor will make off-site arrangements for safe storage at no additional cost. All required insurance for the off site storage location must be obtained by the Contractor.

D) Storage of materials within the buildings shall be stacked and distributed so as not to exceed the floor live and dead load limits indicated on the contract documents. See structural drawings for details. The storage of this type of material must be reviewed prior to placement with the Owner. Please note the former sanctuary space (upper floor) shall not be used for material storage due to its historic significance/ finishes.

4.6 Site Stockpiles

Due to the limited site conditions, site stockpiles will need to be reviewed with the Owner.

4.7 Equipment Locations

The locations of all cranes, mixers, boom trucks, forklifts, welding machines, generators, field offices, workbenches, cutters, hose lines, other equipment, etc., must be approved by Owner prior to utilization and placement on the project site. In addition, any Contractor wishing to place a crane upon this project for the purpose of lifting materials or equipment must submit a lifting procedure safety plan and a current crane inspection certificate. This Contractor will be responsible to erect, remove, maintain, modify, and replace any required safety barriers and temporary protection. Crane placement on adjacent City of Niagara Falls owned parking lot will need to be reviewed and approved by the City prior to mobilization.

4.8 Security

A) There will be a requirement for the selected contractor to provide on-site security to keep the project site, material storage/ equipment secure. The project site shall have on-site security 7 days a week with 24 hours per day coverage. It will up to the selected contractor if they want to forego on-site security during normal business hours (say 7 AM- 3 PM) while contractors work on site. Liability of a secure project site, material storage and equipment will be the responsibility of the selected contractor.

B) ALL on site Contractors shall remain solely responsible for any loss or damage to their property, operations, or employee's property. During all hours, the Contractor shall safeguard materials and equipment in storage on the project site, including work in place or

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in process of fabrication against theft, acts of malicious mischief, vandalism, and other losses or damages.

4.9 Site Fence/Security

A) The General Contractor shall provide, MAINTAIN, and ultimately remove all temporary chain link and orange snow fencing, large gates, man gates, and padlocks. The fence installation must start no later than five (5) working days after the notice to proceed is given and must be 100% complete no later than **5 days**. The Contractor shall maintain and lubricate locks monthly to ensure proper operation. (2) Gate keys should be provided and turned over to Owner. There shall be a continuous, top horizontal rail, and chain link fabric shall be attached using heavy-duty wire (no zip strips will be allowed) at locations where excavations will occur. All other areas of the project work area shall be protected with an orange snow fence to deter access to the project site. The fence shall remain until such time final grading and seeding work will be done or as directed by Owner. The General Contractor shall provide continuous maintenance of fencing and immediate repair of fencing if the site's integrity or security is compromised.

4.10 Work Outside of Site Fence

Any contract work that must be performed outside the limits of the site project fence must be carefully coordinated ahead of time with Niagara University and/or City of Niagara Falls. If work includes any further obstruction of traffic or pedestrians, work must be performed as directed and reviewed by Niagara University. The Contractor shall provide all flag men and barricades necessary for the safe access and egress around the site relating to their work. Any street closure or traffic permits required for the performance of work outside the limits of the site fence will be the responsibility of the Contractor.

5.0 CONSTRUCTION SCHEDULE

5.1 Schedule Responsibilities

A general overall construction project milestone summary schedule has been provided. Prior to the bid due date, each Contractor shall review this schedule and provide feedback with regard to activity duration and sequence of its work. It is the responsibility of the Contractor to indicate any and all scheduling problems before bids are due. There will be no extensions of time to this schedule. PLEASE NOTE: THE END DATE IS DEFINED FOR OWNER USE. THE CONTRACTOR IS RESPONSIBLE TO HAVE ALL WORK COMPLETE AND 100% CODE COMPLIANT FOR USE BY THE DEFINED DATES. THERE WILL BE NO EXCEPTIONS.

If it becomes apparent that any single activity completion date may not be met, the Contractor shall take some or all of the following actions at no cost to the Owner:

- A) Increase construction manpower in such quantities as to eliminate the backlog of work and put the Project back on schedule.
- B) Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of construction equipment, or any combination of the foregoing as will substantially eliminate the backlog of work and put the Project back on schedule. Additional costs for supervision by the Architect or Owner for overtime or shiftwork will be the Contractor's responsibility as a result of the Contractor's negligence.
- C) Reschedule activities to put the Project back on schedule. If the Contractor fails to take any of the above actions within twenty-four (24) hours after receiving written notice, the Owner will take appropriate action involving contractual commitments and performance bonds. The Owner retains the right to back charge the Contractor (as determined by the A/E) for any and all costs resulting from scheduling delays.

5.2 Expediting

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The Contractor shall be responsible for the cost of expediting all fabrication and delivery of its materials. Should, in the opinion of Owner, it become necessary in order to maintain job progress for Owner to supplement the Contractor's expediting efforts, then all costs incurred by Owner and/or the Architect/Engineer shall be backcharged to the Contractor as Owner may elect. If necessary, the Contractor is required to pay fees associated with site visits by Owner or the Architect/Engineer to manufacturing facilities producing materials for the project.

5.3 Continuous Operations / Out of Sequence Work

Work will be coordinated in an attempt to allow continuous installation by Contractors. This will not always be possible and comeback and/or out of sequence work will be required to complete the construction on the part of all Contractors. Out of sequence work, ordered by the Owner, which may be required to meet the job schedule, building occupancy requirements, or allow the Owner to use the facilities, shall be included in the base bid prices.

5.4 Project Coordination

- A) Coordinate construction activities included under various sections of the specifications to assure efficient and orderly installation of each part and type of the work. Coordinate construction operations included under different sections of the specifications that are dependent upon each other for proper installation, connection, and operation. Where installation of one part of the work is dependent on the installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair. Make adequate provisions to accommodate items scheduled for later installation. Verify that anchorage, blocking, joining, and other detailing are provided as required. Do not obstruct spaces required by Code Requirements in front of construction, access doors, or equipment. Coordinate all related questions regarding this issue through Owner and AE.
- B) Existing facilities outside and adjacent to the Project Area will continue to be in operation during the construction period. The Contractor shall schedule and arrange the work to provide minimum inconvenience to the community. Keep all adjacent areas around and leading to and from the work areas clean and free of debris at all times.
- C) Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the work. Such administrative procedures include, but are not limited to, the following:
 - 1. Preparation of schedules;
 - 2. Installation and removal of temporary facilities;
 - 3. Delivery and processing of submittals;
 - 4. Installation and removal of mock-ups;
 - 5. Progress meetings;
 - 6. Delivery of progress payments;
 - 7. Etc.

6.0 JOBSITE RULES

6.1 Work Hours

- A) In general, the project will be open from **7:00 am to 5:00 pm**.
- B) If the Contractor or the Owner feels overtime hours are necessary to meet the contractual schedule commitment of the Contractor, the Contractor shall work such overtime hours, additional shifts, weekends and/or Holidays.

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- C) If the Contractor causes a delay in the schedule due to its own negligence, the negligence of its subcontractor or supplier will be held responsible for the recovery of the schedule to minimize the effect on other Contractors.

6.2 Jobsite Meetings

A) Job meetings will be held at a predetermined day and time each week at the jobsite. Project Managers will be required to attend each meeting. Any and all coordination and schedule related issues will be discussed and reviewed in these meetings.

B) The Company Foreman/PM will provide a written, one-week look ahead schedule for review and coordination at the meeting a minimum of 24 hours prior to the scheduled progress meeting. The schedule will show all activities individually, with start/end dates, show which activities critical path based on the overall schedule, and durations will be shown in days.

6.3 Project Staff

A) The Contractors shall provide qualified and experienced Project staff including, but not limited to, Project Manager, Coordinator/Project Engineer, Quality Assurance/Quality Control Coordinator, Environmental Health and Safety Officer, and Superintendents/Foremen. Failure to maintain a Superintendent on the Project site at all times work is in progress shall be considered a material breach of the Contract, entitling the Owner to seek equitable reimbursement by the Contractor, for durations until the Superintendent is on the Project Site full time. All communication given to or produced by the project staff shall be binding as if given to or produced by the Contractor. The project staff shall be in attendance at the project site not less than eight hours per day, five days per week, the Contractor or any other entity shall not employ members of the project staff on any other project during their specified term at this project site.

6.4 Communication

A) The on-site Superintendents/Foremen must have a working **cellular phone** with voicemail for the duration of the project and during all on-site working hours.

B) Mobile Phone / Job Radios - The Contractor shall be available to the Owner, Architect 24 hours a day/7 days a week by means of a mobile phone/job radio provided by the Contractor. The Contractor will be required to furnish a job phone/radio to their project manager, superintendent, or job foreman. If the Contractor does not provide the job radio/phone to its Project Manager, Superintendent, or Job Foreman as required, the Owner will furnish a job radio/phone to the Contractor's Project Manager, Superintendent, or Job Foreman and the cost of the phone plus a fee of \$500.00 per phone will be deducted from the Contractor's pay application.

6.5 Daily Construction Reports

By 10:00 AM the following workday, The Contractors will submit to Owner, daily manpower counts and a DETAILED description/location of the previous day's activities including quantities and specific locations of work performed. Manpower shall be broken down by job classification (Foreman, Journeyman or Apprentice). In addition, the Prime Contractor shall include on his form the above information for all of his subcontractors. The report shall also note all deliveries, equipment on site, whether inspections passed or failed.

6.6 Signage

Signs, logos, etc. will be permitted on the Contractor's own equipment but not on the site fence, shanties, or building unless otherwise approved by Owner. Post required notices and construction signage information as required by all governing agencies:

- ESD (Empire State Development)
- HUD (Community Project Funding)
- EDA (Economic Development Agency)- see signage requirements in bid documents

6.7 Jobsite Conduct

A) Each Contractor's management should review with their employees that it is imperative that their conduct be socially acceptable at all times. Vulgar or abusive language, sexually

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suggestive comments or gestures, and vulgar language on clothing are strictly prohibited and will result in immediate removal from the jobsite and/or criminal prosecution.

- B) **Smoking is absolutely prohibited** on all **University Property** including areas within the construction fencing and parking areas. If employees smoke on adjacent public property, it is expected that any garbage or debris will be properly disposed of.

6.8 Clothing

Proper attire is required on-site at ALL times. Full-length pants, shirts with sleeves and hard sole work boots are required. No shorts, tank tops, or sneakers will be allowed.

6.9 Lunch Areas

Contractors and workers will contain their breaks and lunch periods to the areas designated by selected contractor. All Contractors must provide, maintain, and empty (1) 50-gallon container (with liners and sealed top) within their break/lunch area for the placement of trash. The areas used for construction lunches are to be kept clean and orderly each day.

6.10 Disruptive Work

Due to construction adjacent to existing public spaces, noise and dust control is essential. All noisy or disruptive work that may affect the adjacent buildings must be scheduled two weeks in advance through Niagara University.

6.11 Shutdowns/Notices/Permit

- A) Contractors are required to strictly comply with all governing laws, rules, regulations, and inspection requirements, both as to labor and materials, pay all fees and permits in connection therewith, and shall bear all loss from any neglect.

6.12 Construction Vehicles

If any construction vehicles are on site, they must be cleaned prior to leaving the site. Any Contractor failing to clean vehicles will be responsible for cleaning the street **immediately upon notification to do so.**

6.13 Excavation/Earthwork

- A.) The General Contractor notify Owner and "UFPO at (800) 962-7962" at least one week prior to the start of the work. Dust control and mud control is the responsibility of the General Contractor and must take appropriate steps to control such per Owner requests or by other local authorities.
- B.) Provide all temporary shoring and bracing as required for excavation type work. All shoring and bracing shall comply with safety regulations of authorities having jurisdiction and shall be developed by a Licensed Professional Engineer.
- C.) Include traffic plates, temporary protection, temporary flagging, etc. over and around any excavation that the Owner feels impedes job movement or safety.
- D.) The General Contractor shall provide and maintain adequate site drainage during the entire construction period in accord with the construction documents through foundation work and the completion of underground, which shall not adversely affect construction progress, abutting property, or the City of Niagara Falls sanitary or storm drainage systems.

6.14 Damages

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- A) The Contractor required to provide all precautions, protection, and the utmost care must be exercised to protect existing structures in accordance with good safety practices. This is particularly applicable to protection for pedestrians. The Contractor will be responsible for any damage, which may occur to the property of the University or adjacent private or public properties which in any way results from the acts or neglect of its employees. In addition, repair and make good, at the expense of the Contractor, all damages thereto including damage to existing utilities and paving arising from operations under the Contract. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

6.15 Testing, Inspections, Permits

- A) The Contractor is responsible for compliance with all applicable local, state, and federal regulations regarding codes, restrictions, and requirements.
- B) Except for testing and inspections performed by a testing agency in the employ of the Architect and/or Owner, the Contractor shall be responsible for the execution of all tests, testing, and inspections required by the specifications and by all governmental authorities having jurisdiction, and shall pay the costs of all such tests, testing and inspection. The Contractors shall submit certified results of the tests and inspections to the Architect's/Engineer's formal approval. The frequency of the tests shall be such as not to delay the work of any following Contractors.
- C) The Contractor is responsible for submission and payment to the City of Niagara Falls for the Certificate of Plan Approval/Building Permit as well as any other project related permits and fees shall be included as part of its bid. The Contractor shall be responsible for scheduling inspections or applicable work in accordance with the Project Schedule.
- D) The Contractor shall obtain all necessary permits and licenses pertaining to the work and shall comply with all Federal, State, Municipal and local laws, ordinances, rules, regulations, standards, orders, notices and requirements including, among others, those relating to safety, discrimination in employment, fair employment practices and equal employment opportunity, whether or not provided for by the Plans, Specifications, General Conditions or other Contract Documents, without additional charge or expense to the Owner, and shall also be responsible for and correct, at its own cost and expense, any violations thereof resulting from or in connection with the performance of its work. The Contractor shall, at any time upon demand, furnish such proof as may require showing such compliance and the correction of such violations. The Contractor agrees to hold harmless and indemnify the Owner, and the Architect/Engineer from and against any and all loss, injury, claims, actions, proceedings, liability, damages, fines, penalties, costs and expenses including legal fees and disbursements caused or occasioned directly or indirectly by the Contractor's failure to comply with any of the said laws, ordinances, rules, regulations, standards, orders, notices or requirements to correct such violations.
- E) Required certificates of inspection, testing, or approval shall be secured by the Contractor and promptly delivered to AE. Requisition for payment may not be accepted or reviewed until all formal test results/reports are brought current.

6.16 Quality Control

- A) In addition to the requirements of the specifications, the following shall also apply to Quality Control for this project. It is in the best interest of both Owner and the Contractor to provide top quality workmanship and materials in accordance with the contract drawings and specifications.
- B) The Contractor, at the Owner's, Architect's direction, may be required to provide mockups prior to the start of any work that is essential to the external or internal appearance or

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function of the building as specified. The Contractor shall allow time for construction and approval of these mockups so no subsequent work is delayed.

- C) Protect construction for quality control service activities until accepted through the Substantial Completion process.
- D) Contractors warrant that all materials and equipment furnished under this Agreement will be new unless otherwise specified, and that all work will be of good quality, free from faults and defects and in conformance with the Contract Documents. All work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment
- E) Manufacturer's Field Services - When directed by Owner or the Architect/Engineer, the Contractor shall direct the manufacturer or supplier to have qualified personnel to provide on-site observations and recommendations at no additional cost to the Owner when there is a problem with workmanship. Representative shall submit written report to Owner and Architect/Engineer listing observations and recommendations. The Manufacturer shall validate the quality of workmanship and materials when required by manufacturer warranty. Comply with manufacturer's installation instructions and recommendations to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- F) Provide attachment and connection devices and methods necessary for securing work as required by the manufacturer, even if they are not clearly illustrated on the Contract Documents.

6.17 Continuing Performance

Pending final resolution of a claim, unless otherwise agreed to in writing, the Contractor shall proceed diligently with performance of the contract, additional work authorized by the Owner, or any work that may be in dispute, and payments shall continue to be made in accordance with the terms of the contract documents.

6.18 Owner Related Issues

- A) In the case of partial occupancy, the warranty period called for by the contract documents shall not commence until substantial completion of all work under the contract.
- B) The Owner shall, have the right to place and install equipment during progress of the work and the Contractor shall agree that such placing and installation of equipment shall not evidence completion of the work or portions of it, nor signify the Owner's acceptance of the work or portions thereof.
- C) Contractors are advised that the Owner may, at its discretion, employ other Contractors or employees to perform work on this project. In such an event, all trades working under this contract shall cooperate in order that the work of all parties can be completed in reasonable order.
- D) The Owner's equipment suppliers shall be provided with reasonable use of power and light (normal working hours) necessary for the installation of their work without additional cost to the Owner or Owner.

7.0 TEMPORARY FACILITIES AND UTILITIES

7.1 Jobsite Material Hoisting

- A) Use of the new elevator lift to transport construction crews, materials, and/or equipment will be prohibited.

7.2 Trash Removal:

- A) The General Contractor shall provide and maintain dumpsters for the use of all the on site

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B) Dumpsters shall be removed within 4-hours of being full and will be hauled off site to a legal dumpsite.

7.3 Drinking Water

Drinking water and ice will be the responsibility of all on site Contractors to provide for their own work forces. Use of the University Facilities will not be allowed.

7.4 Fire Extinguishers

A) The Contractor and its subcontractors must supply a 20 lb fire extinguisher in jobsite trailers, at flammable material storage areas, and at all locations where welding, cutting or burning occurs.

7.5 Temporary Water

A.) The General Contractor shall provide temporary water, piping, and spigots to coordinate with the needs, requirements, and locations.

B.) Maintain temporary plumbing and permanent work if being used as temporary for the life of the project. Prevent freeze ups, including any insulation, heat tracing, temporary enclosures, and temporary power. Install drain valves at low points of the system, the use of traps shall be avoided if possible. All warranties for permanent equipment being used during project construction shall be extended to give the Owner full warranty as required from the date of substantial completion.

C.) Temporary work shall not interfere with any permanent construction. If interference occurs, the General Contractor shall make the required changes to remove interference and include the cost of the changes as part of their lump sum contract.

D.) The sub Contractors performing site work and/or landscaping work are to provide water supply for construction activities via a water truck or use of a fire hydrant with proof of proper permit submitted to General Contractor and Owner prior to use.

E.) Any damages to finish work due to negligence or careless use of water by any Contractor will be repaired by the General Contractor.

7.6 Temporary Heating, Cooling, Ventilation and Humidity Control

Temporary unit provided by the General Contractor shall be arranged to bring in sufficient outdoor air to ventilate the structure and to prevent build up of harmful dusts and fumes and to remove excess moisture. During warm weather, provide an adequate supply of fresh air (minimum 1-1 1/2 air changes per hour), when necessary, to properly ventilate moisture, dust, fumes from paints, cements, or adhesives in tightly enclosed areas where natural ventilation will not be sufficient.

Please note: the former sanctuary space located on the upper floor will need be temporarily ventilated during construction to protect the historic space and finishes

7.7 Temporary Power and Lighting

A.) The General Contractor shall also furnish, install, maintain, and remove the temporary interior electrical power .

1. Use transformers and panel boards to convert the power as required for lighting. All panels shall be securely and neatly installed on substantial framework and mounted on the floor. Any panel installation which does not meet the approval of the Owner and the Architect/Engineer shall be remounted in an approved manner.

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2. Temporary wiring is to be laid out, balanced, and sized so as to produce a voltage drop of no more than 5 percent at the extreme end of the line when operating at full load.
3. **General Building Lighting:** Distribution for general lighting will be made from a distribution board to temporary 15 amp branch fused lighting lockable panels mounted on moveable stands by the General Contractor. From these lighting panels, 3 wire #12 circuit wiring will distribute lighting on a basis of an average 10 foot-candles per square foot for the entire floor area and at least one lamp per room, closet, stairwell, etc. All light fixtures are to have non-current carrying safety guards. Lighting is to be circuited to permit 25% lighting for off-work hours or as required by codes. All fixtures are to include protective guards on all lamps with a minimum of one (1) 100-Watt light bulb per new or renovated room. Temporary wiring will be of a moveable nature and will be required at various locations as the work progresses. Charges for moving or relocating temporary lights shall be included as part of the maintenance costs. The General Contractor is to provide three (3) 500 watt quartz lights with minimum 10 feet of cord on stands for miscellaneous lighting.

- B.) **Project Temporary Power:** In addition to the specific requirements indicated herein, there will be 120-volt power receptacles. Provide a minimum of two (2) double duplex GFCI receptacles for 120-volt service mounted on moveable plywood stands throughout the building and serviced from the local temporary power panel. The moveable stands shall be provided so that no more than 100' of extension cord would be required to reach any point in project area.
- C.) The installation of temporary power and lighting shall conform to all Federal, State, and Local requirements, and must comply with the National Electrical Code and the Health Standards of OSHA.
- D.) Temporary work must be installed in such a manner as to not interfere with permanent construction. If such interference does occur, it is the responsibility of the General Contractor to relocate the temporary electrical interference immediately for the continuous work of other trades. The cost of any such work shall be included in the General Contractor's contract.
- E.) Temporary lighting and power is to be removed as the job progresses, including the coordinating of patching of all finishes interrupted by this service. Temporary materials, upon removal by the Electrical Contractor, shall become the property of the Contractor. **No temporary wire or lighting materials shall be permitted to be left in work areas.**
- F.) The Contractor shall clearly label all safety disconnect switches as to the equipment or panel that it powers. Current panel schedules are to be located at each lighting panel.

7.8 Temporary Toilets
Will be provided by the GC.

7.9 Temporary Offices

- A) Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls and foundation adequate for normal loading.
- B) Common Use Field Office: Of sufficient size to accommodate needs of Owner, Architect and

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construction personnel for progress meetings. Keep office clean and orderly. Furnish and equip offices as follows: Furniture required for project-site documents including file cabinets, plan tables, plan racks and bookcases.

7.10 Site Dewatering

The General Contractor is to make provisions for dewatering so as not to impede the job progress. The General Contractor shall employ trenches, drains, sumps, or other necessary elements as required, to afford satisfactory work conditions for the execution and completion of the work.

7.11 Snow/Ice Removal from the construction areas are the responsibility of the contractor as necessary to allow for no disruption of construction activities.

7.12 Ladders/ Rough Carpentry are the responsibility of the contractor.

7.13 Benchmarks and Building Control Lines are the responsibility of the contractor.

7.14 Temporary Shoring and Bracing

Provide temporary shoring and bracing as required for the execution of the work. All shoring and bracing shall comply with safety regulations of authorities having jurisdiction and shall be designed by a Professional Engineer licensed in the State of NY.

7.15 Temporary Signage (Project Specific)

A) The Contractor is responsible and required to post and notify the public and other Contractors prior to any work beginning. This is to include all types of safety signage throughout the duration of the project.

B) The General Contractor shall furnish, install, MAINTAIN, and ultimately remove the following signage for the duration of the project. (ALL SIGNS SHALL BE BOLTED WITH TAMPERPROOF FASTENERS):

1. (2) "CAUTION CONSTRUCTION ENTRANCE AHEAD" Provide this sign on a post near the main entrance gate. The exact location will be determined in the field by Owner. Sign to be Blaze Orange reflective background with black lettering (3' x 3')
2. (2) "CONTRACTOR PARKING" Provide this sign on a post. The exact location will be determined in the field by Owner. The sign is to be white reflective background with black lettering (2'x2').
3. (2) "HARD HAT/SAFETY GLASSES REQUIRED BEYOND THIS POINT" signs at each man/vehicle entrance into the project site. Signs are to have white, reflective backgrounds with blue lettering (3'0" x 3).

C) The General contractor shall provide funding signage per bid documents- project construction signage as required by ESD, HUD and EDA agencies with project numbers, names and logos.

7.16 Removal and Reconditioning

Any temporary facilities, barricades, utilities, and other temporary construction shall be removed from the project site as soon as the progress of the work will permit in the opinion of the Owner and Architect/Engineer. Legally dispose of all debris resulting from the removal and recondition operations.

8.0 GENERAL PROTECTION AND SAFETY

8.1 Site Safety Plan

The Contractor Safety programs, along with any additions and/or modifications that may be necessary over the duration of the project, should assist in helping to keep accidents at a minimum during the construction. This program is to be used in conjunction with the Contractor's own safety program. Contractors must realize that accident prevention is

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mandatory, and beneficial to all. The responsibility of every individual on this project is to have a safe job site for the duration of the project.

Owner expects the full cooperation of all Contractors, regardless of tier, monitoring, supervision, and enforcing the project safety and fire prevention program, including all requirements by the Owner.

- A) The safety of the Contractor and its subcontractors, and their representatives, agents, employees and invitees, while on the work site, or of any other person who enters upon the work site with the consent of Contractor, subcontractors or the representatives, agents, employees or invitees of any of them for reasons relating to the Contract, shall be the sole responsibility of Contractor. Contractor shall at all times maintain good order among its employees and shall not employ, for purposes of the Contract, any person unfit or not skilled in the work assigned.
- B) Contractor shall, at all times during the performance of the Contract, take all measures and precautions to (i) protect the property of the Owner and others, and (ii) prevent injury, illness or death to any person. Such measures and precaution shall include, but shall not be limited to, all safeguards and warnings necessary (i) to protect all persons against any condition, including exposure to health hazard, on the work site which could be dangerous and (ii) to prevent accidents of any kind whenever the Work is being performed, particularly where the work is being performed in proximity to any moving or operating machinery, equipment or facilities, whether such machinery, equipment or facilities are the property of or are being operated by, Contractor, its subcontractors, Owner, or other persons.
- C) Contractor shall promptly comply and shall at all times during the performance of the Contract take all measures and precautions necessary to ensure that subcontractors and their representatives, agents, employees and invitees shall promptly comply with any and all of Owner's requirements, if any, to initiate corrective action for deficiencies regarding (i) the prevention of accidents or fires or (ii) the elimination of accident hazards, fire hazards or unsafe practices.
- D) Contractors shall comply, and shall at all times during the performance of the Contract take all measures and precautions necessary to ensure that subcontractors and their representatives, agents, employees and invitees shall comply with all federal, state and local safety, health and environmental laws, rules, regulations, ordinances, orders, decrees, decisions, restrictions and permits and licenses including, but not limited to, the Occupational Safety and Health Act, 29 U.S.C. § 651 *et. seq.*; as they have been or will be amended from time to time, and the regulations implementing such statutes; any similar state and local laws and ordinances concerning the protection of human health and the environment and the regulations implementing such statutes.
- E) Contractor shall comply, and shall at all times during the performance of the Contract take all measures and precautions necessary to ensure that subcontractors and their representative, agents employees and invitees shall comply, with such regulations, policies and procedures as Owner may from time to time establish.
- F) Contractor shall not introduce, and shall at all times during the performance of the Contract take all measures and precautions necessary to ensure that subcontractors and their representatives, agents, employees and invitees shall not introduce, onto the Work site any Hazardous Substance with prior written approval. "Hazardous Substance(s)" means (i) any substance, material, chemical or waste which is or shall be listed or defined as hazardous, toxic or dangerous under any Applicable Environmental Law, or (ii) any petroleum products, or (iii) any substance, material, chemical or waste which is or may become, directly or indirectly, by chemical reactions or otherwise, hazardous, toxic or dangerous to life, health, property or the environment by reason of toxicity, flammability, explosiveness, corrosivity or any other reasons.

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- G) "Applicable Environmental Law" means any and all laws concerning the protection of human health and the environment which include, but shall not be limited to, the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§ 9601, et seq.; the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901, et seq.; the Federal Water Pollution Control Act, 33 U.S.C. §§ et seq.; the Clean Air Act, 42 U.S.C. §§ 7401 et seq.; the Hazardous Materials Transportation Act, 49 U.S.C §§ 1471 et seq.; the Toxic Substances Control Act, 15 U.S.C. §§ 2601 through 2629; and the Safe Drinking Water Act, 42 U.S.C. §§ 300f through 300j; as they have been or will be amended from time to time, and the regulations implementing such statutes; and any similar state and local laws and ordinances concerning the protection of human health and the environment and the regulates implementing such statutes.

8.2 Safety Program

Owner requires contractors to be responsible for maintaining a safe job. This will be insured by the following means:

- A. **All construction employees shall wear a hard hat and safety glasses at all times.** Other safety protection shall be as dictated by the work. Each Contractor shall keep spares of each in their gang box for new employees and replacement. Violators will be removed from the site.
- B. In accordance with OSHA standards, each Contractor will hold weekly "Tool Box" meetings with jobsite personnel to discuss safety. Minutes of each (handwritten) of these meetings shall be turned in weekly with the hazmat log to the Owner.
- C. All Contractors (including delivery drivers) persons employed on the job site are required to wear a hard hat and eye protection as a condition of employment. There are no exceptions to this rule. Contractors will provide its workers with all necessary personal protective equipment and tools and enforce the use of same.
- D. Aluminum or steel ladders are not allowed on this project (they are electrical conductors).
- E. Steel erectors and metal deck installers are required to utilize 100% positive fall protection at all times.
- F. Not used.
- G. The Contractor is expected to have a scheduled maintenance program for all tools and equipment.
- H. Contractors are responsible to remove and replace in original positions barricades, railings, covers, etc., in accordance with subpart M, OSHA 1926,500. The unguarded opening(s) shall be manned until the barricade is replaced. During discontinuous or intermittent work operation, safety protection is to be replaced immediately. If not promptly replaced, replacement will be by others at the removing contractor's expense.
- I. All electrically operated tools and equipment must be properly grounded with the exception of approved insulated types.
- J. Only low velocity powder actuated tools can be used. All personnel must be certified when using powder activated tools and laser devices. All use of these tools must be approved and be logged in with the Owner prior to their usage, as well as, posting all proper signage.
- K. All compressed gas cylinders must be properly handled. They must always be in the upright position and properly secured when stored. Cylinders are to be separated by a minimum of 15 feet. All oxygen and acetylene cylinders in use should be secured on a special carrier with a fire extinguisher.
- L. All shanties and trailers must be supplied with a current 20# ABC fire extinguisher, an OSHA approved first aid kit and a copy of the OSHA Construction Standards. A prominent

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sign is required at the extinguishers location. If gang boxes are used instead of a shanty, the gang box shall contain the above.

- M. Take all necessary precautions to avoid fires. Provide Hot Work Permits and fire watches when welding or burning operations are in progress.
- N. The Owner is to be notified immediately of any accident on the project site. Contractors shall provide accident reports to the Owner direct no later than (24) hours after an accident occurs.
- O. All project employees shall wear attire suitable for construction work. They shall wear shirts with sleeves, long trousers and proper shoes at all times. No shorts, tank tops or tennis shoes shall be permitted.
- P. The Contractor is responsible for all his subcontractors and suppliers safety compliance, regardless of tier, with the Contractor's project safety program, and all Federal, State and Local Codes and Regulations.
- Q. The Contractor shall have at least one (1) qualified first aid person and competent person on the Project at all times. The name of this person and date of certification shall be submitted to the Owner at the start of his work and any change shall be noted on the weekly Tool Box Talk Minutes.
- R. Alcoholic beverages or illegal drugs are **not** permitted on this Project.
- S. **Personal radios with earphones are not permitted on this Project.** Loud radio playing is a potential hazard, disrupting to building occupants and is not permitted.
- T. All extension cords, cables and hoses shall be maintained at least 6 feet 6 inches above the working floor. Where this is impossible, these items shall be inspected daily and repaired immediately or tagged and removed from use until repaired.
- U. All temporary electrical installations and all extension cords shall conform to the latest OSHA Construction Standards.
- V. The Contractor shall be responsible for maintaining general housekeeping in their work area and all debris shall be placed in debris containers.
- W. In accordance with the provisions of the HAZARD COMMUNICATION STANDARD 29 CFR-1926, Material and Safety Data Sheets for any chemical/substance along with any additional information, safety data or supplemental material safety data sheets available now or in the future are required to be submitted to Owner prior to material deliveries to the site. Failure to comply with the agreement may result in Owner receiving a citation from the Occupational Safety and Health Administration (OSHA), for violation of the Hazard Communication Standard. The Contractor shall be responsible for all costs to Owner for such citations issued in connection with the Contractor's material.
The Contractor shall be responsible for, but not limited to, the following conditions as it relates to the Hazards Communications Act:
 - 1. Set up and conduct a program for its employees at.
 - 2. Maintain an updated chemical inventory sheet an MSDS's, which must be coordinated and shared with Owner and all other subcontractors at the jobsite. Contractors shall turn these in with copies of their Tool Box Talks.
 - 3. The Contractor is responsible for maintaining an updated file for this jobsite for all hazards that may be encountered on the job.

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4. The Contractor is responsible for labeling and identifying materials (per OSHA requirements) used by him and sharing this information with all other contractors and subcontractors at the jobsite.
5. Training and documentation of training in hazard communications is the responsibility of the Contractor.
6. The Contractor is responsible to coordinate with Owner in satisfying all OSHA requirements.
7. All documentation of respiratory "Fit Test", medical records, etc., shall be submitted prior to any work shall be performed requiring such protection.

The specific listing of the items above does not exclude the Contractor from following all OSHA requirements. The Contractor and all subcontractors are required to meet ALL OSHA SAFETY REQUIREMENTS on this project.

8.3 Protection of Utilities/Facilities

- A) Prior to beginning any work on site, the Contractor shall carefully survey the existing work and examine the site for pre-existing damage. The Contractor shall document via photographs, videos, etc., any existing adjacent facilities that may be potentially effected by the work of this project.
- B) The Contractor is cautioned that since the project site is located adjacent to existing occupied buildings, all precautions, protection, and care must be exercised to protect existing structures in accordance with good safety practices that are appropriate for work.
- C) Any shoring or bracing (including removal of same) required for the completion of Contract scope is the responsibility of the Contractor.
- D) The Contractor is required to have a "competent" person on site during the performance of their work as defined by OSHA.

8.4 Dust Protection

- A) Each on site Contractor is responsible for dust control and cleanup.
- B) When truck traffic conditions produce dust, the roadway must be sprinkled with water and/or swept to minimize the generation of dust or debris. All truck wheels must be inspected, and any loose material removed, prior to leaving the project site.

8.5 Air Pollution and Odor Control

- A) Each Contractor shall employ measures to prevent creation of air pollution and odors. On interior work and work adjacent to occupied areas, all passageways and vent systems will be sealed to prevent dust, air pollution, and odors from traveling into occupied areas. Measures shall be taken by the each Contractor to ensure proper separation, by use of taped fire retardant visqueen tenting, or other separator. Each Contractor has responsibility to insure that the integrity of the separation is maintained throughout the period of the work. For the safety of all occupants, gas or diesel engines are not permitted inside the building after it is enclosed. In the event any Contractor must remove a barrier, it is the responsibility of the General Contractor that the barrier is reconstructed at the end of each work period.
- B) If the omission of construction related odors is found to be offensive by the University, the work will stop and efforts to effectively exhaust the odors will begin immediately. Continuance of the odor causing work will be permitted once a revised plan of action has been developed, reviewed, and approved. Any additional costs associated shall be borne by the General Contractor.

8.6 Protection of the Public

In addition to the general requirements of the contract, it is the Contractor's responsibility to barricade or otherwise separate the work area from public access and/or exposure. Maintain barricades and signs in a clean and neat, graffiti free condition. Particular attention must be given to the isolation/protection of pedestrian and vehicular traffic at the perimeter of the Project

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Site. Any work that must be performed outside of the site fence must be accompanied by the appropriate protection (by the Contractor).

8.7 Protection of Finished Work

As work is completed, contractors shall protection or prevent access to completed areas so not to damage. Any damages by contractor shall be the responsibility of that contractor to repair or replace in kind.

8.8 Cutting and Patching

- A) All patching shall be done by tradesmen who are skilled in the required work. All patchwork will be done to the highest quality standards. The Contractor shall include the cost of all cutting and patching required in connection with performance of its work. Include supports, protection from elements, protection of surroundings, and immediate clean up.
- B) All Sub contractors affected by temporary utilities/openings shall include the necessary comeback to infill, patch, repair, caulk, seal, and/or etc.
- C) Do not cut and patch structural elements in a manner that would reduce their load carrying capacity or load-deflection ratio. Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety. If possible retain the original installer or fabricator to cut and patch exposed work or, if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm.
- D) If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect, consult with the Owner's representative prior to placement.
- E) If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding. Protect existing construction during cutting and patching to prevent damage. Until provisions have been made to bypass them, take all precautions necessary to avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated.
- F) Where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required. Temporarily cover openings when noting use. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
- G) Where removal of walls or partitions extends one finished area into another: Patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance; Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance; Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat; patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.
- H) The Contractor will follow all applicable regulatory hot and safe work procedures when performing welding, cutting, torching, grinding, brazing, or tacking, including protecting personnel and the adjacent work area from fire hazards. Store paints, varnishes, volatile oils, and similar combustible materials in properly labeled storage containers and in storage area as required by law. Store gasoline and other volatile flammable liquids in properly labeled storage containers and in storage area as required by law.

8.9 Perimeter Fall Protection is the responsibility of the contractor.

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8.10 Traffic Control

The Contractor shall provide traffic control barriers and flag persons throughout the construction period at any point in time that construction traffic obstructs normal traffic conditions. Provide flag persons at pedestrian crossing locations where construction equipment passes right of ways 100% of the time. Provide and maintain adequate traffic control and flag persons at all points where transporting of equipment and materials engaged on the work regularly enters and exits from the job site. Provide a number of flag persons necessary for vehicular and pedestrian traffic control. Provide temporary traffic control barriers to ensure safety of all persons and property in accordance with NYSDOT. The Contractor requiring the same shall provide the above.

8.0 CLEAN-UP

9.1 Cleaning, Trash Removal & Dumpsters

On site dumpsters shall be provided as per Section 7.2 of the Special Provisions.

- A) **The Contractor is responsible for DAILY PROJECT CLEANUP! This includes cleaning, sweeping, pick-up, trash/debris removal to the dumpsters.**
- B) The Contractor is responsible for the legal disposal of the debris from the project site. The demolition, remediation, debris and materials removal from the site are the responsibility of the Contractor. Throughout the construction period, maintain the buildings and site in a standard of cleanliness as described in this. In addition to the standards described in this Section, comply with pertinent requirements of governmental agencies having jurisdiction.

10.0 SUBMITTALS AND SHOP DRAWINGS

10.1 General Submittal Information

The Contractor is required to submit to AE within ten (10) days of Notice to Proceed, a submittal log for review and approval. The log must contain as a minimum, a description of each required submittal, the specification number, the date of submittal delivery needed to maintain the project schedule, the date required on jobsite (ROJ) and the estimated material lead-time.

The Contractor is required to make prompt submissions of all Shop Drawings and/or samples in such a sequence so that the material and/or equipment can be reviewed by the Architect/Engineer and returned as soon as possible so as not to delay job progress. No extension of contract time will be authorized because of the Contractor's failure to comply with the approved submittal schedule or failure to transmit submittals to Architect sufficiently in advance of the work to permit processing. Also, no additional time will be allowed the Contractor for delays caused by an excessive number of re-submittals. The Contractor is responsible for A/E costs after 3 submission attempts. Contractors shall follow procedures as outlined in specification section.

Any and all delays caused by failure to submit Shop Drawings and computations in a timely manner are the responsibility of the Contractor.

All submittals must be accompanied with a letter of transmittal. **Any deviation from the plans or specifications must be noted on the transmittal and clouded on the item submitted for approval.** Deviations from the contract documents require clear indication (clouded or circled) on the submittal and specific written acceptance by the Architect of the noted deviation.

ANY DEVIATIONS FROM ACCEPTED BID SCOPE OF WORK OR SPECIFICATION WILL NOT BE ACCEPTABLE WITHOUT PRIOR APPROVAL BY OWNER AND FUNDING AGENCY REVIEW.

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Where printed product data includes information on several products, some of which are not required, mark (flag or circle) copies to indicate the applicable information.

All submittals are to be sent directly to the AE.

1. Product Data and Manufacturer's Instructions – submit copies as detailed in specification section.
2. Samples - submit copies as detailed in specification section.
3. Samples for Selection- submit copies as detailed in specification section
4. Samples for Verification- submit copies as detailed in specification section.
5. Shop drawings – Initial, submit three (3) prints or one (1) reproducible and (3) prints. The (1) reproducible will be returned to the Contractor. Final, submit six (6) prints and two (2) additional prints if required for the maintenance manuals. Three (3) prints will be retained and the remainder returned.

The Contractor is responsible for the reproduction, distribution, and coordination of all submittal materials to their own sub-subcontractors.

Approval of a drawing or sample is not to be interpreted as an approval of a change in contract price or recognition of a claim for a change in contract price. It is the Contractor's obligation, upon submitting a shop drawing or a sample, which involves a change in contract price, which is not covered by specific authorization, to include with their submission a request for a change with an estimate of the cost of the change.

Do not permit submittals marked "Rejected, Revise and Resubmit" to be used at the job site, or elsewhere where work is in progress

10.2 M/E/P/FP/TC/GC Coordination Drawings

The following coordination program is to be used in conjunction with that described in the project specifications. Where the two programs differ, the more stringent requirement will be followed. Site investigation of existing conditions is to begin immediately. The General Contractor with its sub contractors M/E/P/FP/TC/GC/GC are to establish and maintain weekly coordination meeting within fifteen (15) working days of Notice to Proceed.

The General Contractor shall provide 3/8"=1'-0" scale CAD drawings on disk(s) for use by M/E/P/FP/TC/GC/GC trades in coordinating their work. All M/E/P/FP/TC/GC Contractors (and affected architectural and structural trade Contractors) will be required to show all of their work on these composite drawings and attend coordination meetings in order to maintain the project schedule and, sign off on final sets of coordinated drawings. Sequence of coordination drawings shall be as follows:

- A) The General Contractor shall provide 3/8"=1'-0" scale CAD drawings on disk(s) with all contract ME work indicated.
- B) **Important:** It shall be the sole responsibility of the General Contractor to coordinate with the Architect/Engineer for the issuance of appropriate CAD disks and associated files, fonts or pen weight information required to produce coordination drawings. The costs for the assembly and delivery of files from the Architect/Engineer will be by the General Contractor. Additionally, the General Contractor shall be responsible to coordinate and ensure that each Contractor understands how to and can properly access and incorporate their work onto the CAD disk(s).
- C) Upon completion, the General Contractor will forward the CAD drawing disk(s) to his ME Fire Protection Contractor who will incorporate all contract document fire protection work on the drawings.

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- D) Each Contractor, after incorporating their work on the composite coordination drawing CAD disk(s) shall forward to the next Contractor and document transmission of the drawings by forwarding a copy of the transmittal to AE.
- E) The sequence of Contractors shall be HVAC Sheet metal, Plumbing, HVAC Piping, Electrical, Fire Protection and GC.
- F) The General Contractor will schedule M/E/P/FP/TC/GC coordination meetings at regular intervals to evaluate the progress and discuss potential conflicts. The Contractor possessing the drawings when meetings are scheduled is responsible to bring the coordination drawings to the meeting.
- G) The General Contractor shall be responsible to plot and provide progress prints when requested by Owner in addition to plotting and providing copies of the final signed off set of coordinated drawings to the Owner, Architect, and, all affected Contractors.
- H) The coordination drawing will accurately locate and dimension the following:
 - 1. Grid layout as per architectural drawings and verified by associated installation Contractors.
 - 2. Light fixtures, transformers, main feeder conduit and racks for electrical and telephone, pull boxes – location, including pendant fixtures, top of fixture elevation and type.
 - 3. Grilles and Diffusers – Location, size and type, and top of take-off box elevation.
 - 4. Access Panels – Location and type (all Contractors).
 - 5. Mechanical equipment, piping, valves, VAVs, pumps, smoke detectors, heat detectors, sprinklers, ceiling heights, etc.
- I) Carefully check and coordinate the location and level of all pipes, ducts, etc. Run preliminary levels and check with all other Contractors so that conflicts in location may be avoided. Where conflicts occur, if any, the following preference schedule shall be followed:
 - 1. Recessed electrical light fixtures.
 - 2. High-pressure ductwork.
 - 3. Low-pressure ductwork.
 - 4. Soil, waste, vent and storm piping.
 - 5. Liquid heat transfer and refrigerant piping.
 - 6. Domestic water piping.
 - 7. Electrical conduits.

However, no ductwork or liquid heat transfer main shall have preference over plumbing lines below plumbing fixtures, or over electrical conduits above or below electric switchgear and panels. No piping conveying liquids shall be installed directly over electrical or elevator equipment.

- J) Once a level is complete, an overall meeting with all participants present will be held to review and resolve conflicts. At this meeting, each Contractor is to have their engineer and draftsman present to identify all conflicts so the conflicts can be resolved. If the individual Contractors cannot resolve a conflict, the decision by Owner and the A/E will be final and binding. At the end of the meeting every Contractor will sign and date each drawing with the revisions noted. The Architects and Engineers will attend this meeting as required.
- K) Final coordination drawings will be distributed by the General Contractors to all parties including the Architect and Engineer, assume 6 sets of prints are required. All work is to be installed as intended by the coordination drawings. Work not so installed is subject to replacement if conflicts occur and at no additional cost to the Owner.
- L) Provide supplementary drawings showing additional work necessary to overcome "tight" conditions, at no increase in Contract Sum. If necessary, and before work proceeds in these areas, prepare supplementary drawings for review showing all work in "tight" areas.

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- M) The Contractor shall obtain field measurements required for the accurate fabrication and installation of the work included in this contract. Exact measurements are the Contractor's responsibility.
- N) Coordination drawings shall be keyed and cross-referenced to the Contract Drawings.
- O) The sizes and bottoms elevations shall be shown for all oval and rectangular ductwork; the sizes and centerline elevations shall be shown for all round ductwork and piping. All major components, such as dampers, valves, controls, pumps, in line devices, cleanouts, etc. shall be dimensioned from column centerlines
- P) Coordination drawings shall show all offsets, fittings and similar items which may interfere with the work of other trades in the areas covered by the coordination drawings so that the work will be installed without interference, within the dimensional limitations indicated, with proper clearances, and will meet the requirements of the Contract Documents without additional expense to Owner. The General Contractor acknowledges that the coordination drawing process is to be a complete process. Regardless of the amount of man hours required to complete the coordination drawing process, Contractors shall not be reimbursed for additional re-configuration, re-design, re-engineering, etc.

10.3 As-Built Drawings

In addition to the requirements of the specifications, the Contractor is required to maintain an up to date set of as-built drawings and to provide one set of these to Owner/AE at the completion of its work. These as-built drawings shall be available for inspection at all times by Owner/AE. If the as-built drawings are not kept up to date, Owner will withhold payment until the as-built drawings are brought up to date. **The as-builts will be inspected at 20%, 40%, 60% & 80% project completion and at other times prior to payment application approval.**

Coordinate construction changes, change order numbers, RFI numbers and similar identification. Give particular attention to information on concealed elements, which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:

- A. Dimensional changes to the Drawings;
- B. Revisions to details shown on the Drawings;
- C. Depths of foundations below the first floor;
- D. Locations and depths of underground utilities;
- E. Revisions to routing of piping and conduits;
- F. Revisions to electrical circuitry;
- G. Actual equipment locations;
- H. Duct size and routing;
- I. Locations of concealed internal utilities;
- J. Changes made by Change Order;
- K. Details not on original Contract Drawings;
- l. Update of all room numbers on Drawings and in Specifications to reflect current building number designations.

Mark record sets with red erasable colored pencil; use other colors to distinguish between changes for different categories of the work at the same location.

11.0 MBE/WBE/EEO POLICY

The contractor shall report and track participation during the project to comply with state and/or federal goals for M/WBE EEO opportunities as outlined in the bid documents. The University

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stresses that it supports the use of minority/women owned businesses and encourages the participation of these businesses on this project.

- A) The funded Non EDA Project Scope of Work shall comply with 18% MBE and 12% WBE goals
- B) The funded EDA Scope of Work shall comply with 7.7 MBE and 6.9% WBE goals.

12.0 PAYMENT PROCEDURES

12.1 Payment Program

- A. Within 10 calendar days of Notice to Proceed, the Contractor is to submit a detailed breakdown (schedule of values) of its costs for approval to the Owner. The breakdown shall be to a level of detail to expedite the reviewing process. Owner reserve the right to direct a larger more detailed breakdown.
- B. The schedule of values will be reviewed and adjusted if necessary. Once approved the schedule of value is to be used for the AIA request for payment application. Only the AIA pay application forms will be recognized for billing purposes. The schedule of values shall reflect the separation of scope of work and billing for each of the funding agencies (ESD, HUD and EDA).
- C. Billing for stored material will be subject to prior written approval by the Owner. If it is approved it would require as minimum 1.) Bill of Sale, 2.) Bill of Sale Lease Agreement, 3.) Loss Payable endorsement, 4.) insurance certificate in an amount not less than the value of the billed material, 5.) a map of the facility where the material is stored, and 6.) visual inspection and photos by Owner.
- D. All deposits and prepayments are the responsibility of the Contractor.
- E. The monthly application "pencil copy" shall be submitted on the 20th of the month or the first working day thereafter to Owner/AE for approval on AIA Form G-702 and G-703 along with a partial release of liens with value of work projected to the end of the month subject to the approval of Owner/AE. Owner/AE will acknowledge agreement with or will provide the required changes. Failure to respond by the 25th day of the month will not constitute agreement.
- F. Final applications for payment, notarized wit original signatures, containing all corrections as indicated by Owner, shall be presented to Owner no later than the 25th day of the month.
- G. Applications shall be submitted to the Architect and Owner for final approval by the 1st working day of the month.
- H. A copy of Partial Waiver of Liens from the Contractor, subcontractors, suppliers, vendors, etc. must accompany each application for payment.
- I. As-builts will be reviewed on a monthly basis along with the pay application. **Failure to maintain and up keep as-builts will impact that Contractor's pay request.** All partial and final applications for payment shall include partial and final waivers respectively.
- J. All funds will be dispersed by Niagara University directly to the Prime Contractors.
- K. Monthly retainage shall be 10% of the work completed in that pay period.

12.2 Changes in the Work

In addition to the requirements of the General Conditions regarding changes in the work, the following shall also apply.

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- A. For proposed changes in the work, the Contractor shall submit an itemized detailed listing of all quantities with the applicable unit cost and extended price for each work item.
- B. As a minimum, the detailed breakdown shall include the following:
 - 1. Actual labor costs, itemized by each trade involved showing the hourly rate for each. Labor rates shall be the same for extra and credit computations.
 - 2. Burden on labor, which shall include the actual costs of mandatory fringe benefits, taxes on labor, workmen's compensation, insurance on labor as affected by payroll, unemployment taxes, including FICA and FUTA.
 - 3. Actual quantities of material and equipment, with their actual unit costs.
 - 4. The cost of contracted work, computed in the same way as provided under this subparagraph.
 - 5. Overhead, profit, or commission.
 - 6. Sales tax or use taxes on materials, if applicable.
- C. All back charges executed by Owner against any Contractor will reflect the direct work costs or subcontracted with appropriate mark-up and an additional 15% administrative cost.
- D. The Contractor shall provide a detailed breakdown to justify the labor burden. The Owner reserve the right to reject any labor burden that is inconsistent with similar Contractors or does not correspond with initial submission of wage breakdowns.
- E. Material costs shall be at the actual cost to the Contractor. Contractor shall submit evidence to substantiate the costs. Material shall be quoted at trade discount prices. For any proposal with material credits, the credit shall be based on the actual contract cost of the material (including trade and quantity discounts) less any charges incurred for handling or returning of a material which has been delivered, or for engineering, fabrication or storage charges. Otherwise, no "cancellation" charge will be allowed when material has not been shipped.

12.3 Formula For Changes

Percentage Markup and Procedures Applicable to work Added to or Omitted from the Original Contract Agreement.

- A. Lump Sum - Predetermined Lump Sum additions and/or omissions to the agreement are to be based upon the estimated "Net Actual Cost", plus the following maximum percentages for Overhead and Profit. On proposals for decreases in the amount of the contract, the overhead and profit will be added to the "Net Actual Cost", thereby increasing the credit that would be deducted from the price of this agreement:

Maximum % for Overhead & Profit:

	Labor	Material	Sublet Work
Additions:	15%	10%	5%
Omissions:	15%	10%	5%

- B. Time & Material - Additional Work to the Contract, authorized by Owner in advance to be performed on a Time & Material Basis, is to be based upon the "Net Actual Cost", plus the following percentage's for Overhead & Profit:

Maximum % for Overhead & Profit:

	Labor	Material	Sublet Work
Additions:	15%	10%	5%

- C. General:

- 1. Submission of lump sum estimates and costs shall be itemized in a form satisfactory to Owner to permit ready analysis and evaluation. On Time & Material Work, daily reports to duplicate showing all field and shop labor expended and/or material delivered, shall be submitted to Owner's Job Staff. Invoices shall be submitted monthly.
- 2. No overhead and profit will be permitted on the premium time portion of any overtime

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work.

3. Percentages shall apply to net difference in quantities for adds and deducts in any one change.
4. Percentages applied by subcontractors for Labor & Material shall not exceed those of Contractors.
5. "Net Actual Cost" defined:
 - a. Labor
 1. Wages of labor, including foreman and general foreman, engaged in this work and directly on Contractor's payroll.
 2. Engineering and drafting performed with Owner's prior approval.
 3. Fringe Benefits established by governing trade organizations.
 4. Federal Old Age Benefits, Federal and State Unemployment Taxes.
 5. Net actual premium paid for Public Liability, Workman's Compensation, Property Damage, and any other forms of insurance required by the Owner.
 - b. Material
 1. Net cost of construction materials and supplies delivered to site, including applicable Sales and/or Use Taxes, transportation costs, trade and cash discounts. (Note: Sales Tax is not applicable to transportation costs).
 2. Costs of a special nature, approved in advance by the Owner, such as for riggers, labor transportation, equipment rentals, royalties, permits and other expenses of this nature.
6. Percentages shall include the following overhead costs:
 - a. Supervision and Executive Expenses (both field and office supervision).
 - b. Small tools; incidental scaffolding, blocking, shores; appliances; sub-contractor's trucks and driver, etc; and the expense of maintaining same.
 - c. Administrative expenses – clerical, accounting, etc.; both at the project and the Contractor's office.
 - d. Project Managers, Engineering costs, Shop Drawings, Proposal Preparation Review, Expediting Costs, etc.
 - e. Taxes required to be paid by the sub-contractor, but not included under the aforementioned "Net Actual Cost".
 - f. Any other miscellaneous general conditions necessary to complete the Change Order.
 - g. The bond costs if applicable.
7. Percentages shall include all profit.

12.4 Access to Accounting Records

The Contractor shall check all materials, equipment, and labor entering into the work and shall keep such full and detailed accounts as may be necessary for proper financial management under this Agreement, and the system shall be satisfactory to the Owner. The Owner or its representative shall be afforded access to all the Contractor's records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda and similar data relating to the contract, and the Contractor shall preserve all such records for a period of three years, or for such longer period as may be required by law, after the final payment.

13.0 **JOB CLOSE-OUT PROCEDURES**

13.1 Punchlist

Upon substantial completion of a major work area and prior to the Owner taking possession of the space, the Architect will conduct a punch list inspection following notification from contractor. After receiving a copy of this punch list, the Contractor shall take immediate, corrective action on all items. When all punch list items have been completed for the job and

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the Owner has accepted the area, and all other closeout submittals are completed final payment will be processed.

13.2 Final Payment Procedure

The following requirements of the Contract Documents shall be fulfilled for Final Payment authorization:

- ❑ Satisfactory completion of construction work and acceptance by the Architect, Construction Manager, and the Owner.
- ❑ Acceptance by the Architect, and the Owner of written warranties and maintenance agreements.
- ❑ Acceptance by the Architect, and the Owner of Record Drawings and "As-built" Drawings.
- ❑ Delivery to Owner of a satisfactory Waiver of Liens upon Final Payment and Guarantee(s).
- ❑ Delivery to AE of a complete list of subcontractors and principal vendors.
- ❑ Delivery to Owner of a complete file of Operations, Training, and Maintenance Manuals.
- ❑ Submission to Owner of an affidavit of all employees, vendors, subcontractors, and other indebtedness connected with the work has been paid in full.
- ❑ Release to Owner of attic stock and "extra" materials.
- ❑ Delivery to Owner of all meter readings for utility services.
- ❑ Delivery to Owner proof that all taxes, fees, and similar obligations have been paid in full.
- ❑ Acceptance by the Architect, and the Owner that all construction equipment, material, etc. has been removed from project site.
- ❑ Acceptance by the Architect, Construction Manager, and the Owner of final clean-up.
- ❑ Submit formal Final Payment original of the Application for Payment to Owner.

13.3 Contract Closeout

Before requesting inspection for certification of Substantial Completion, complete the following, and list exceptions in the request. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100% completion for the portion of the work claimed as substantially complete. Include supporting documents for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the work is not complete. Advise Owner of pending insurance changeover requirements. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, lien releases, and similar documents. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates, and similar releases. Deliver tools, spare parts, extra stock, and similar items. Advise the Owner's personnel of changeover in security provision.

Complete start-up testing of systems, and instruction (training) of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements. Where extra materials of value remaining after completion of associated work have become the Owner's property, arrange for disposition of these materials as directed. Complete final clean up requirements, including touch-up painting as required.

13.4 Operation and Maintenance Data

The manual shall flag significant points to be observed or attended with the words "Attention:" and a brief description of the notice or action to be taken, separated from main text, in bold or italic type. Where operation poses hazard or risk to the operator, staff, patients, or the facility, the point shall be flagged with the word "Warning:" and a brief description of the hazard or action to be taken, separated from the main text, in bold or italic type. The procedures shall also clearly indicate the limits of work, which may be performed by other than manufacturers' or installers' personnel during the warranty period without violating equipment warranties. Contractor shall submit the specified quantities.

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13.5 Training

The Architect will identify those items of equipment and systems for which the Contractor shall provide formal training. The Contractor shall develop a proposed training plan for review and approval by the Owner. The plan shall provide for the completion of all required training prior to beneficial occupancy of the facility and shall include: 1.) A weekly outline of all scheduled training, both classroom and on-site, describing the proposed presentation, 2.) day-to-day schedule showing times, major and subordinate subjects to be taught, and 3.) locations. The Contractor shall provide all equipment, media, and trained personnel to visually and audibly record all instruction-training sessions to be formalized and turned over to the Owner.

13.6 Warranties

Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers, and/or sub-subcontractors required to countersign special warranties with the Contractor. Warranties specified in the individual specification sections are in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents. In all cases, periods of warranties and guaranties shall not commence until the item being warranted or guaranteed is accepted by the Owner. Upon determination that Work covered by a warranty has failed, replace and rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

13.7 Commissioning – NOT USED

END OF OWNER'S SPECIAL PROVISIONS

GENERAL CONDITIONS TO BID

NON-COLLUSIVE BIDDING CERTIFICATION

No bid will be accepted that does not have this form completely executed.

By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of knowledge and belief:

- (a) The prices in this 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 prices with any other bidder or any competitor;
- (b) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor;
- (c) No attempt has been made or will be made by the bidder to induce any other person, partnership, or corporation to submit or not to submit a bid for the purpose of restricting competition;
- (d) The person signing this bid or proposal certifies that he has fully informed himself regarding the accuracy of the statements contained in this certification, and under the penalties of perjury, affirms the truth thereof, such penalties being applicable to the bidder as well as to the person signing in its behalf;
- (e) That attached hereto (if corporate bidder) is a certified copy of resolution authorizing the execution of this certified by the signature of this bid or proposal in behalf of the corporate bidder.

(Individual) (Corporation)

Dated: _____ By _____
(Signature of Officer)

This Non-Collusive Bidding Certificate must be submitted with the bid.

PROPOSED M/WBE UTILIZATION PLAN

List all MWBE consultants, contractors, subcontractors and suppliers anticipated to be used during the performance of this Agreement:

Firm Name: _____
Address: _____

Value of Proposed Award: \$ _____
Fed ID No. _____

City: _____ State: _____ Zip: _____

Estimated Start Date: _____

Contact Person: _____
Email Address: _____
Work Description: _____

Telephone: _____
Type of Firm: MBE WBE

▪ Firm Name: _____
Address: _____

Value of Proposed Award: \$ _____
Fed ID No. _____

City: _____ State: _____ Zip: _____

Estimated Start Date: _____

Contact Person: _____
Email Address: _____
Work Description: _____

Telephone: _____
Type of Firm: MBE WBE

▪ Firm Name: _____
Address: _____

Value of Proposed Award: \$ _____
Fed ID No. _____

City: _____ State: _____ Zip: _____

Estimated Start Date: _____

Contact Person: _____
Email Address: _____
Work Description: _____

Telephone: _____
Type of Firm: MBE WBE

▪ Firm Name: _____
Address: _____

Value of Proposed Award: \$ _____
Fed ID No. _____

City: _____ State: _____ Zip: _____

Estimated Start Date: _____

Contact Person: _____
Email Address: _____
Work Description: _____

Telephone: _____
Type of Firm: MBE WBE

CERTIFIED CORPORATE RESOLUTION

RESOLVED THAT _____ be authorized to sign and submit the bid or proposal of this corporation for the following project:

and to include in such bid or proposal the certificate as to non-collusion required by section one hundred three-d (103-d) of the general municipal law as to the act and deed of such corporation, and for any inaccuracies or mis-statements in such certificate this corporate bidder shall be liable under the penalties of perjury.

The foregoing is a true and correct copy of the resolution and adopted by

_____ at a meeting of its board of directors held on the

_____ day of _____ 202__ .

(Secretary)

This Certified Corporate Resolution must be submitted with the bid.

Attachment A:

Niagara University Insurance Requirements

Prior to (a) the performance of their duties under this agreement and/or (b) entering the premises of Niagara University or Niagara University Ice Complex, Inc. (whichever is first), and for the duration of the agreement, [Counterparty Abbrev.] shall, at its own cost and expense, maintain the following insurance coverages written for not less than the limits specified for each coverage or required by law, whichever is greater (except that if [Counterparty Abbrev.] maintains any required coverage limits that are higher than the limits specified or required by law, then those higher limits shall apply as though stated and required herein), and shall include the provisions enumerated below. The insurance carriers must be licensed to do so in New York State, must be rated no lower than “A” by the most recent Best’s Key Rating Guide, and must have a Best’s Financial Size Category of not less than VIII, unless otherwise agreed to by Niagara University. The Certificate of Insurance provided must include a complete waiver of subrogation against Niagara University and Niagara University Ice Complex, Inc.

1. Commercial General Liability (CGL) (per ISO Form CG 00 01 or equivalent)

Bodily Injury and Property Damage Limit	\$ 1,000,000 each occurrence
Personal Injury & Advertising Injury Limit	\$ 1,000,000 each person or organization
General Aggregate Limit	\$ 2,000,000 applied separately to each project
Products/Completed Operations Aggregate Limit	\$ 2,000,000
Medical Expense	\$5,000 any one person

- ❖ Coverage shall include independent contractors, all premises used, and all operations performed under the agreement with no designated premises or designated operations limitation.
- ❖ Coverage shall apply on an occurrence basis.
- ❖ **Niagara University and Niagara University Ice Complex, Inc.** shall be included as Additional Insureds on a primary and noncontributory basis using ISO Form CG 20 10, Form CG 20 37, or endorsements providing equivalent coverage to the additional insureds. This insurance shall apply before any other insurance or self-insurance, including any deductible, maintained by or provided to the additional insured.
- ❖ No exclusion or limitation of coverage for sexual abuse or molestation shall be permitted.
- ❖ No endorsement or modification of this policy limiting the scope of coverage for Contractual Liability, Products/Completed Operations, Personal Injury, or Participants Injury shall be permitted.

2. Automobile Liability

Business Auto Liability	\$1,000,000 each accident
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- ❖ Must include coverage for liability arising out of all owned, leased, hired, and non-owned automobiles used in connection with this agreement, if any.

3. Commercial Umbrella

- ❖ Umbrella limits must be at least \$1,000,000 and must provide coverage over all underlying policies.
- ❖ Umbrella coverage must include as additional insureds all entities that are additional insureds on the CGL.

4. Workers’ Compensation and Employer’s Liability

Employers Liability	\$500,000 each accident for bodily injury
	\$500,000 each employee for injury by disease
	\$500,000 policy limit for disease

- ❖ Statutory coverage complying with the law of New York State and of any other state whose laws may govern the benefits available to [Counterparty Abbrev.] or their employees.
- ❖ Where applicable, U.S. Longshore and Harbor Workers’ Compensation Act Endorsement and/or Maritime Coverage Endorsement shall be attached to the policy.

5. Waiver of Subrogation

[Counterparty Abbrev.] shall waive all rights against Niagara University and Niagara University Ice Complex, Inc., and their agents, officers, directors, and employees for recovery of damages to the extent these damages are covered by commercial general liability, commercial umbrella liability, business auto liability or workers compensation and employers liability insurance maintained per requirements stated above and where permitted by law.

6. Certificates of Insurance

- ❖ [Counterparty Abbrev.] shall provide valid Certificates of Insurance (COI) verifying that the foregoing insurance requirements have been met, including all applicable additional insured endorsements and policy provision(s) with the required primary and noncontributory additional insured coverage, at least five (5) business days prior to commencing work under the agreement or to entering the University's premises, whichever is first.
- ❖ The certificate holder shall be designated as:
 - Niagara University and Niagara University Ice Complex, Inc.
 - Attn: Purchasing Manager, Controller's Office
 - Alumni Hall 102B
 - 5795 Lewiston Road
 - Niagara University, NY 14109.
- ❖ The certificate of insurance shall accurately state that the Commercial General Liability Coverage does not exclude or limit coverage for sexual abuse or molestation.
- ❖ Upon cancellation or non-renewal of any insurance policy prior to or during the period encompassing when services are performed or the premises are used, [Counterparty Abbrev.] shall immediately deliver to Niagara University a Certificate of Insurance evidencing the replacement or renewal coverage. There shall be no gap in coverage.

Any questions about the insurance requirements or certificate of insurance should be directed to the Purchasing Manager at 716-286-8362.

U. S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT ADMINISTRATION



EDA CONTRACTING PROVISIONS FOR CONSTRUCTION PROJECTS

These EDA Contracting Provisions for Construction Projects (EDA Contracting Provisions) are intended for use by recipients receiving federal assistance from the U. S. Department of Commerce - Economic Development Administration (EDA). They contain provisions specific to EDA and other federal provisions not normally found in non-federal contract documents. The requirements contained herein must be incorporated into all construction contracts and subcontracts funded wholly or in part with federal assistance from EDA.

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1. **DEFINITIONS**

Agreement – The written instrument that is evidence of the agreement between the Owner and the Contractor overseeing the Work.

Architect/Engineer - The person or other entity engaged by the Recipient to perform architectural, engineering, design, and other services related to the work as provided for in the contract.

Contract – The entire and integrated written agreement between the Owner and the Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

Contract Documents – Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents.

Contractor – The individual or entity with whom the Owner has entered into the Agreement.

Drawings or Plans – That part of the Contract Documents prepared or approved by the Architect/Engineer that graphically shows the scope, extent, and character of the Work to be performed by the Contractor.

EDA - The United States of America acting through the Economic Development Administration of the U.S. Department of Commerce or any other person designated to act on its behalf. EDA has agreed to provide financial assistance to the Owner, which includes assistance in financing the Work to be performed under this Contract. Notwithstanding EDA's role, nothing in this Contract shall be construed to create any contractual relationship between the Contractor and EDA.

Owner – The individual or entity with whom the Contractor has entered into the Agreement and for whom the Work is to be performed.

Project – The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

Recipient – A non-Federal entity receiving a Federal financial assistance award directly from EDA to carry out an activity under an EDA program, including any EDA-approved successor to the entity.

Specifications – That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

Subcontractor – An individual or entity having direct contract with the Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

Work – The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

2. **APPLICABILITY**

The Project to which the construction work covered by this Contract pertains is being assisted by the United States of America through federal assistance provided by the U.S. Department of Commerce - Economic Development Administration (EDA). Neither EDA, nor any of its departments, entities, or employees is a party to this Contract. The following EDA Contracting Provisions are included in this Contract and all subcontracts or related instruments pursuant to the provisions applicable to such federal assistance from EDA.

3. **FEDERALLY REQUIRED CONTRACT PROVISIONS**

(a) All contracts in excess of the simplified acquisition threshold - currently fixed at \$150,000 (*see* 41 U.S.C. §§ 134 and 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 may be appropriate.

(b) All contracts in excess of \$10,000 must address termination for cause and for convenience by the Recipient including the manner by which it will be effected and the basis for settlement.

(c) All construction contracts awarded in excess of \$10,000 by recipients of federal assistance and their contractors or subcontractors shall contain a provision requiring compliance with Executive Order 11246 of September 24, 1965, *Equal Employment Opportunity*, as amended by Executive Order 11375 of October 13, 1967, and Department of Labor implementing regulations at 41 C.F.R. part 60.

(d) All prime construction contracts in excess of \$2,000 awarded by Recipients must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. §§ 3141-3148) as supplemented by Department of Labor regulations at 29 C.F.R. part 5. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (18 U.S.C. § 874 and 40 U.S.C. § 3145) as supplemented by Department of Labor regulations at 29 C.F.R. part 3.

(e) All contracts awarded by the Recipient 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 (the Contract Work Hours and Safety Standards Act) as supplemented by Department of Labor regulations at 29 C.F.R. part 5.

(f) All contracts must include EDA requirements and regulations that involve a requirement on the contractor or sub-contractor to report information to EDA, the Recipient or any other federal agency.

- (g) All contracts must include EDA requirements and regulations pertaining to patent rights with respect to any discovery or invention which arises or is developed in the course of or under such contract.
- (h) All contracts must include EDA requirements and regulations pertaining to copyrights and rights in data.
- (i) All contracts and subgrants in excess of \$150,000 must contain a provision that requires compliance with all applicable standards, orders, or requirements issued under the Clean Air Act (42 U.S.C. § 7401 *et seq.*) and the Federal Water Pollution Control Act (Clean Water Act) (33 U.S.C. § 1251 *et seq.*), and Executive Order 11738, *Providing for Administration of the Clean Air Act and the Federal Water Pollution Control Act With Respect to Federal Contracts, Grants, or Loans*.
- (j) Contracts must contain 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 (42 U.S.C. § 6201).
- (k) Contracts must contain a provision ensuring that contracts are not to be made to parties on the government wide Excluded Parties List System in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 C.F.R. part 180.
- (l) Contracts must contain a provision ensure compliance with the Byrd Anti-Lobbying Amendment (31 U.S.C. § 1352) under which contractors that apply or bid for an award of \$100,000 or more 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.
- (m) If the Recipient is a state agency or agency of a political subdivision of a state, any contract awarded must contain a provision ensuring compliance with section 6002 of the Solid Waste Disposal Act (42 U.S.C. § 6962), as amended by the Resource Conservation and Recovery Act related to the procurement of recovered materials.

4. **REQUIRED PROVISIONS DEEMED INSERTED**

Each and every provision of law and clause required by law to be inserted in this contract shall be deemed to be inserted herein and the contract shall be read and enforced as though it were included herein, and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party the contract shall forthwith be physically amended to make such insertion of correction.

5. **INSPECTION BY EDA REPRESENTATIVES**

The authorized representatives and agents of EDA shall be permitted to inspect all work, materials, payrolls, personnel records, invoices of materials, and other relevant data and records.

6. **EXAMINATION AND RETENTION OF CONTRACTOR'S RECORDS**

(a) The Owner, EDA, or the Comptroller General of the United States, or any of their duly authorized representatives shall, generally until three years after final payment under this contract, have access to and the right to examine any of the Contractor's directly pertinent books, documents, papers, or other records involving transactions related to this contract for the purpose of making audit, examination, excerpts, and transcriptions.

(b) The Contractor agrees to include in first-tier subcontracts under this contract a clause substantially the same as paragraph (a) above. "Subcontract," as used in this clause, excludes purchase orders that do not exceed \$10,000.

(c) The periods of access and examination in paragraphs (a) and (b) above for records relating to (1) appeals under the disputes clause of this contract, (2) litigation or settlement of claims arising from the performance of this contract, or (3) costs and expenses of this contract to which the Owner, EDA, or Comptroller General or any of their duly authorized representatives has taken exception shall continue until disposition of such appeals, litigation, claims, or exceptions.

7. **CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES**

Immediately after execution and delivery of the contract, and before the first partial payment is made, the Contractor shall deliver to the Owner an estimated construction progress schedule in a form satisfactory to the Owner, showing the proposed dates of commencement and completion of each of the various subdivisions of work required under the Contract Documents and the anticipated amount of each monthly payment that will become due to the Contractor in accordance with the progress schedule. The Contractor also shall furnish the Owner (a) a detailed estimate giving a complete breakdown of the contract price and (b) periodic itemized estimates of work done for the purpose of making partial payments thereon. The costs employed in making up any of these schedules will be used only to determine the basis of partial payments and will not be considered as fixing a basis for additions to or deductions from the contract price.

8. **CONTRACTOR'S TITLE TO MATERIAL**

No materials, supplies, or equipment for the work shall be purchased by the Contractor or by any subcontractor that is subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. The Contractor warrants and guarantees that he/she has good title to all work, materials, and equipment used by him/her in the Work, free and clear of all liens, claims, or encumbrances.

9. **INSPECTION AND TESTING OF MATERIALS**

All materials and equipment used in the completion of the Work shall be subject to adequate inspection and testing in accordance with accepted standards. The laboratory or inspection agency shall be selected by the Owner. Materials of construction, particularly those upon which the strength and durability of any structure may depend, shall be subject to inspection and testing to establish conformance with specifications and suitability for intended uses.

10. **"OR EQUAL" CLAUSE**

Whenever a material, article, or piece of equipment is identified in the Contract Documents by reference to manufacturers' or vendors' names, trade names, catalogue numbers, etc., it is intended merely to establish a standard. Any material, article, or equipment of other manufacturers and vendors that will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or equipment so proposed is, in the opinion of the Architect/Engineer, of equal substance and function. However, such substitution material, article, or equipment shall not be purchased or installed by the Contractor without the Architect/Engineer's written approval.

11. **PATENT FEES AND ROYALTIES**

(a) Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device that is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Architect/Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by the Owner in the Contract Documents.

(b) To the fullest extent permitted by Laws and Regulations, the Contractor shall indemnify and hold harmless the Owner and the Architect/Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

12. **CLAIMS FOR EXTRA COSTS**

No claims for extra work or cost shall be allowed unless the same was done in pursuance of a written order from the Architect/Engineer approved by the Owner.

13. **CONTRACTORS AND SUBCONTRACTORS INSURANCE**

(a) The Contractor shall not commence work under this Contract until the Contractor has obtained all insurance reasonably required by the Owner, nor shall the Contractor allow any subcontractor to commence work on his/her subcontract until the insurance required of the subcontractor has been so obtained and approved.

(b) Types of insurance normally required are:

- (1) Workers' Compensation
- (2) Contractor's Public Liability and Property Damage
- (3) Contractor's Vehicle Liability
- (4) Subcontractors' Public Liability, Property Damage and Vehicle Liability
- (5) Builder's Risk (Fire and Extended Coverage)

(c) **Scope of Insurance and Special Hazards:** The insurance obtained, which is described above, shall provide adequate protection for the Contractor and his/her subcontractors, respectively, against damage claims that may arise from operations under this contract, whether such operations be by the insured or by anyone directly or indirectly employed by him/her and also against any of the special hazards that may be encountered in the performance of this Contract.

(d) **Proof of Carriage of Insurance:** The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates, and dates of expiration of applicable insurance policies.

14. **CONTRACT SECURITY BONDS**

(a) If the amount of this Contract exceeds \$150,000, the Contractor shall furnish a performance bond in an amount at least equal to one hundred percent (100%) of the Contract price as security for the faithful performance of this Contract and also a payment bond in an amount equal to one hundred percent (100%) of the Contract price or in a penal sum not less than that prescribed by State, Territorial, or local law, as security for the payment of all persons performing labor on the Work under this Contract and furnishing materials in connection with this Contract. The performance bond and the payment bond may be in one or in separate instruments in accordance with local law. Before final acceptance, each bond must be approved by EDA. If the amount of this Contract does not exceed \$150,000, the Owner shall specify the amount of the payment and performance bonds.

(b) All bonds shall be in the form prescribed by the Contract Documents except as otherwise provided in applicable laws or regulations, and shall be executed by such sureties as are named in the current list of *Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies* as published in Treasury Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's

authority to act. Surety companies executing the bonds must also be authorized to transact business in the state where the Work is located.

15. **LABOR STANDARDS - DAVIS-BACON AND RELATED ACTS**
(as required by section 602 of PWEDA)

(a) **Minimum Wages**

(1) All laborers and mechanics employed or working upon the site of the Work 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 at 29 C.F.R. part 3, the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at the 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 that 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 29 C.F.R.

§ 5.5(a)(1)(iv); 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 29 C.F.R. § 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 determined under 29 C.F.R. § 5.5(a)(1)(ii) 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.

(2) (i) Any class of laborers or mechanics to be employed under the Contract, but not listed in the wage determination, shall be classified in conformance with the wage determination. EDA shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(A) The work to be performed by the classification requested is not performed by a classification in the wage determination;

(B) The classification is utilized in the area by the construction industry; and

(C) The proposed wage rate, including any bona fide fringe benefits, bears a

reasonable relationship to the wage rates contained in the wage determination.

(ii) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and EDA or its designee 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 EDA or its designee to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210.

(iii) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and EDA or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), EDA or its designee shall refer the questions, including the views of all interested parties and the recommendation of EDA or its designee, to the Administrator for determination.

(iv) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(2)(ii) or (iii) 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.

(3) 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.

(4) 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.

(b) **Withholding**

EDA or its designee 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 in the construction or development of the Project, all or part of the wages required by the Contract, EDA or its designee 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. EDA or its designee may, after written notice to the Contractor, disburse such amounts withheld for and on account of the Contractor or subcontractor to the respective employees to whom they are due. The Comptroller General shall make such disbursements in the case of direct Davis-Bacon Act contracts.

(c) **Payrolls and basic records**

(1) 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 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, the plan or program is financially responsible, and the plan or program has been communicated in writing to the laborers or mechanics affected, and provide records that 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.

(2) (i) For each week in which Contract work is performed, the Contractor shall submit a copy of all payrolls to the Owner for transmission to EDA or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 C.F.R. part 5.5(a)(3)(i). This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose. It may be purchased from the Superintendent of Documents (Federal Stock Number 029-005-00014-1), U.S. Government Printing Office, Washington, D.C. 20402; or downloaded from the U.S. Department of Labor's website at <https://www.dol.gov/whd/forms/wh347.pdf>. The prime Contractor is responsible for the submission of copies of payrolls by all subcontractors

(ii) 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:

(A) That the payroll for the payroll period contains the information required to be maintained under 29 C.F.R. § 5.5(a)(3)(i) and that such information is correct and complete;

(B) 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 29 C.F.R. part 3; and

(C) 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.

(iii) 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 15(c)(2)(ii) of this section.

(iv) 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 3729 of Title 31 of the U.S. Code.

(3) The Contractor or subcontractor shall make the records required under paragraph 15(c)(1) of this section available for inspection, copying, or transcription by authorized representatives of EDA or its designee 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, EDA or its designee may, after written notice to the Contractor 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.

(d) **Apprentices and Trainees.**

(1) **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, Bureau of Apprenticeship and Training (Bureau), or with a State Apprenticeship Agency recognized by the Bureau, 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 Bureau of Apprenticeship and Training 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 Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, 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.

(2) **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 that 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's 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.

(3) **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, *Equal Employment Opportunity*, as amended, and 29 C.F.R. part 30.

(e) **Compliance with Copeland Anti-Kickback Act Requirements.** The Contractor shall comply with the Copeland Anti-Kickback Act (18 U.S.C. § 874 and 40 U.S.C. § 3145) as supplemented by Department of Labor regulations (29 C.F.R. part 3, “Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States”). The Act provides that the Contractor and any subcontractors shall 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 they are otherwise entitled. The Owner shall report all suspected or reported violations to EDA.

(f) **Subcontracts.** The Contractor and any subcontractors will insert in any subcontracts the clauses contained in 29 C.F.R. §§ 5.5(a)(1) through (10) and such other clauses as EDA or its designee may 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.

(g) **Contract termination; debarment.** The 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.

(h) **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.

(i) **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 EDA or its designee, the U.S. Department of Labor, or the employees or their representatives.

(j) **Certification of Eligibility.**

(1) By entering into this Contract, the Contractor certifies that neither it nor any person or firm that 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).

(2) 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).

(3) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. § 1001.

16. **LABOR STANDARDS - CONTRACT WORK HOURS AND SAFETY STANDARDS ACT**

As used in this paragraph, the terms “laborers” and “mechanics” include watchmen and guards.

(a) **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 that person 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.

(b) **Violation; liability for unpaid wages, liquidated damages.** In the event of any violation of the clause set forth in paragraph (a) of this section, the Contractor and any subcontractor responsible therefore 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 (a) of this section, in the sum of \$10 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 (a) of this section.

(c) **Withholding for unpaid wages and liquidated damages.** EDA or its designee 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 monies 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) of this section.

(d) **Subcontracts.** The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs (a) through (c) 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 (a) through (c) of this section.

17. **EQUAL EMPLOYMENT OPPORTUNITY**

(a) The Recipient hereby agrees that it will incorporate or cause to be incorporated into any contract for construction work, or modification thereof, as defined in the regulations of the Secretary of Labor at 41 C.F.R. chapter 60, which is paid for in whole or in part with funds obtained from EDA, the following equal opportunity clause:

During the performance of this contract, the Contractor agrees as follows:

Economic Development Administration
Contracting Provisions for Construction Projects

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, 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 to be provided setting forth the provisions of this nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

(4) The Contractor will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers representatives of the Contractor's commitments hereunder, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965 and of the rules, regulations, and relevant orders of the Secretary of Labor.

(6) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by EDA and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the Contractor's noncompliance with the nondiscrimination clauses of

this Contract or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts or federally-assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.

(8) The Contractor will include the portion of the sentence immediately preceding paragraph 17(a)(1) and the provisions of paragraphs 17(a)(1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as EDA or the Secretary of Labor may direct as a means of enforcing such provisions, including sanctions for noncompliance. Provided, however, that in the event the Contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by EDA or the Secretary of Labor, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

(9) The Recipient further agrees that it will be bound by the above equal opportunity clause with respect to its own employment practices when it participates in federally-assisted construction work. Provided, however, that if the Recipient so participating is a State or local government, the above equal opportunity clause is not applicable to any agency, instrumentality, or subdivision of such government that does not participate in work on or under the Contract.

(10) The Recipient agrees that it will assist and cooperate actively with EDA and the Secretary of Labor in obtaining the compliance of contractors and subcontractors with the equal opportunity clause and the rules, regulations, and relevant orders of the Secretary of Labor, that it will furnish EDA and the Secretary of Labor such information as they may require for the supervision of such compliance, and that it will otherwise assist EDA in the discharge of the EDA's primary responsibility for securing compliance.

(11) The Recipient further agrees that it will refrain from entering into any contract or contract modification subject to Executive Order 11246 of September 24, 1965, with a Contractor debarred from, or who has not demonstrated eligibility for, Government contracts and federally assisted construction contracts pursuant to the Executive Order and will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by EDA or the Secretary of Labor pursuant to Part II, Subpart D of the Executive Order. In addition, the Recipient agrees that if it fails or refuses to comply with these undertakings, EDA may take any or all of the following actions: Cancel, terminate, or suspend in whole or in part this EDA financial assistance; refrain from extending any further assistance to the applicant under the program with respect to which the failure or refund occurred until satisfactory assurance of future compliance has been received from such applicant; and refer the case

to the Department of Justice for appropriate legal proceedings.

(b) Exemptions to Above Equal Opportunity Clause (41 C.F.R. chapter 60):

(1) Contracts and subcontracts not exceeding \$10,000 (other than Government bills of lading, and other than contracts and subcontracts with depositories of Federal funds in any amount and with financial institutions which are issuing and paying agents for U.S. savings bonds and savings notes) are exempt. The amount of the Contract, rather than the amount of the federal financial assistance, shall govern in determining the applicability of this exemption.

(2) Except in the case of subcontractors for the performance of construction work at the site of construction, the clause shall not be required to be inserted in subcontracts below the second tier.

(3) Contracts and subcontracts not exceeding \$10,000 for standard commercial supplies or raw materials are exempt.

18. **CONTRACTING WITH SMALL, MINORITY AND WOMEN'S BUSINESSES**

(a) If the Contractor intends to let any subcontracts for a portion of the work, the Contractor shall take affirmative steps to assure that small, minority and women's businesses are used when possible as sources of supplies, equipment, construction, and services.

(b) Affirmative steps shall consist of:

(1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;

(2) Ensuring that small and minority businesses and women's business enterprises are solicited whenever they are potential sources;

(3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses and women's business enterprises;

(4) Establishing delivery schedules, where the requirements of the contract permit, which encourage participation by small and minority businesses and women's business enterprises;

(5) Using the services and assistance of the U.S. Small Business Administration, the Minority Business Development Agency of the U.S. Department of Commerce, and State and local governmental small business agencies;

(6) Requiring each party to a subcontract to take the affirmative steps of this section; and

(7) The Contractor is encouraged to procure goods and services from labor surplus area firms.

19. **HEALTH, SAFETY, AND ACCIDENT PREVENTION**

(a) In performing this contract, the Contractor shall:

- (1) Ensure that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to their health and/or safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation;
- (2) Protect the lives, health, and safety of other persons;
- (3) Prevent damage to property, materials, supplies, and equipment; and
- (4) Avoid work interruptions.

(b) For these purposes, the Contractor shall:

- (1) Comply with regulations and standards issued by the Secretary of Labor at 29 C.F.R. part 1926. Failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act (40 U.S.C. §§ 3701 – 3708); and
- (2) Include the terms of this clause in every subcontract so that such terms will be binding on each subcontractor.

(c) The Contractor shall maintain an accurate record of exposure data on all accidents incident to work performed under this Contract resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment, and shall report this data in the manner prescribed by 29 C.F.R. part 1904.

(d) The Owner shall notify the Contractor of any noncompliance with these requirements and of the corrective action required. This notice, when delivered to the Contractor or the Contractor's representative at the site of the Work, shall be deemed sufficient notice of the noncompliance and corrective action required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to take corrective action promptly, the Owner may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. The Contractor shall not base any claim or request for equitable adjustment for additional time or money on any stop order issued under these circumstances.

(e) The Contractor shall be responsible for its subcontractors' compliance with the provisions of this clause. The Contractor shall take such action with respect to any subcontract as EDA, or the Secretary of Labor shall direct as a means of enforcing such provisions.

20. **CONFLICT OF INTEREST AND OTHER PROHIBITED INTERESTS**

- (a) No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept, or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the Project, shall become directly or indirectly interested personally in this Contract or in any part hereof.
- (b) No officer, employee, architect, attorney, engineer, or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the Project, shall become directly or indirectly interested personally in this Contract or in any part thereof, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the Project.
- (c) The Contractor may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the Contract Documents has a corporate or financial affiliation with the supplier or manufacturer.
- (d) The Owner's officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, may be involved. Such a conflict may arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest in the Contractor. The Owner's officers, employees, or agents shall neither solicit nor accept gratuities, favors, or anything of monetary value from the Contractor or subcontractors.
- (e) If the Owner finds after a notice and hearing that the Contractor, or any of the Contractor's agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of the Owner or EDA in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, the Owner may, by written notice to the Contractor, terminate this Contract. The Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which the Owner bases such findings shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.
- (f) In the event this Contract is terminated as provided in paragraph (e) of this section, the Owner may pursue the same remedies against the Contractor as it could pursue in the event of a breach of this Contract by the Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, the Owner may pursue exemplary damages in an amount (as determined by the Owner) which shall not be less than three nor more than ten times the costs the Contractor incurs in providing any such gratuities to any such officer or employee.

21. **RESTRICTIONS ON LOBBYING**

(a) This Contract, or subcontract is subject to 31 U.S.C. § 1352, regarding lobbying restrictions. The section is explained in the common rule, 15 C.F.R. part 28 (55 FR 6736-6748, February 26, 1990). Each bidder under this Contract or subcontract is generally prohibited from using federal funds for lobbying the Executive or Legislative Branches of the Federal Government in connection with this EDA Award.

(b) **Contract Clause Threshold:** This Contract Clause regarding lobbying must be included in each bid for a contract or subcontract exceeding \$100,000 of federal funds at any tier under the EDA Award.

(c) **Certification and Disclosure:** Each bidder of a contract or subcontract exceeding \$100,000 of federal funds at any tier under the federal Award must file Form CD-512, *Certification Regarding Lobbying – Lower Tier Covered Transactions*, and, if applicable, Standard Form-LLL, *Disclosure of Lobbying Activities*, regarding the use of any nonfederal funds for lobbying. Certifications shall be retained by the Contractor or subcontractor at the next higher tier. All disclosure forms, however, shall be forwarded from tier to tier until received by the Recipient of the EDA Award, who shall forward all disclosure forms to EDA.

(d) **Continuing Disclosure Requirement:** Each Contractor or subcontractor that is subject to the Certification and Disclosure provision of this Contract Clause is required to file a disclosure form at the end of each calendar quarter in which there occurs any event that requires disclosure or that materially affects the accuracy of the information contained in any disclosure form previously filed by such person. Disclosure forms shall be forwarded from tier to tier until received by the Recipient of the EDA Award, who shall forward all disclosure forms to EDA.

(e) **Indian Tribes, Tribal Organizations, or Other Indian Organizations:** Indian tribes, tribal organizations, or any other Indian organizations, including Alaskan Native organizations, are excluded from the above lobbying restrictions and reporting requirements, but only with respect to expenditures that are by such tribes or organizations for lobbying activities permitted by other federal law. An Indian tribe or organization that is seeking an exclusion from Certification and Disclosure requirements must provide EDA with the citation of the provision or provisions of federal law upon which it relies to conduct lobbying activities that would otherwise be subject to the prohibitions in and to the Certification and Disclosure requirements of 31 U.S.C. § 1352, preferably through an attorney's opinion. Note, also, that a non-Indian subrecipient, contractor, or subcontractor under an award to an Indian tribe, for example, is subject to the restrictions and reporting requirements.

22. **HISTORICAL AND ARCHAEOLOGICAL DATA PRESERVATION**

The Contractor agrees to facilitate the preservation and enhancement of structures and objects of historical, architectural or archaeological significance and when such items are found and/or unearthed during the course of project construction. Any excavation by the Contractor that uncovers an historical or archaeological artifact shall be immediately reported to the Owner and a representative of EDA. Construction shall be temporarily halted pending the notification process and further directions issued by EDA after consultation with the State Historic

Preservation Officer (SHPO) for recovery of the items. *See* the National Historic Preservation Act of 1966 (54 U.S.C. § 300101 *et seq.*, formerly at 16 U.S.C. § 470 *et seq.*) and Executive Order No. 11593 of May 31, 1971.

23. **CLEAN AIR AND WATER**

Applicable to Contracts in Excess of \$150,000

(a) **Definition.** “Facility” means any building, plant, installation, structure, mine, vessel, or other floating craft, location, or site of operations, owned, leased, or supervised by the Contractor or any subcontractor, used in the performance of the Contract or any subcontract. When a location or site of operations includes more than one building, plant, installation, or structure, the entire location or site shall be deemed a facility except when the Administrator, or a designee, of the United States Environmental Protection Agency (EPA) determines that independent facilities are collocated in one geographical area.

(b) In compliance with regulations issued by the EPA, 2 C.F.R. part 1532, pursuant to the Clean Air Act, as amended (42 U.S.C. § 7401 *et seq.*); the Federal Water Pollution Control Act, as amended (33 U.S.C. § 1251 *et seq.*); and Executive Order 11738, the Contractor agrees to:

(1) Not utilize any facility in the performance of this contract or any subcontract which is listed on the Excluded Parties List System, part of the System for Award Management (SAM), pursuant to 2 C.F.R. part 1532 for the duration of time that the facility remains on the list;

(2) Promptly notify the Owner if a facility the Contractor intends to use in the performance of this contract is on the Excluded Parties List System or the Contractor knows that it has been recommended to be placed on the List;

(3) Comply with all requirements of the Clean Air Act and the Federal Water Pollution Control Act, including the requirements of section 114 of the Clean Air Act and section 308 of the Federal Water Pollution Control Act, and all applicable clean air and clean water standards; and

(4) Include or cause to be included the provisions of this clause in every subcontract and take such action as EDA may direct as a means of enforcing such provisions.

24. **USE OF LEAD-BASED PAINTS ON RESIDENTIAL STRUCTURES**

(a) If the work under this Contract involves construction or rehabilitation of residential structures over \$5,000, the Contractor shall comply with the Lead-based Paint Poisoning Prevention Act (42 U.S.C. § 4831). The Contractor shall assure that paint or other surface coatings used in a residential property does not contain lead equal to or in excess of 1.0 milligram per square centimeter or 0.5 percent by weight or 5,000 parts per million (ppm) by weight. For purposes of this section, “residential property” means a dwelling unit, common areas, building exterior surfaces, and any surrounding land, including outbuildings, fences and play equipment affixed to the land, belonging to an owner and available for use by residents, but not

including land used for agricultural, commercial, industrial or other non-residential purposes, and not including paint on the pavement of parking lots, garages, or roadways.

- (b) As a condition to receiving assistance under PWEDA, recipients shall assure that the restriction against the use of lead-based paint is included in all contracts and subcontracts involving the use of federal funds.

25. **ENERGY EFFICIENCY**

The Contractor shall comply with all standards and policies relating to energy efficiency which are contained in the energy conservation plan issued in compliance with the Energy Policy and Conservation Act (42 U.S.C. § 6201) for the State in which the Work under the Contract is performed.

26. **ENVIRONMENTAL REQUIREMENTS**

When constructing a Project involving trenching and/or other related earth excavations, the Contractor shall comply with the following environmental constraints:

- (1) **Wetlands.** When disposing of excess, spoil, or other construction materials on public or private property, the Contractor shall not fill in or otherwise convert wetlands.
- (2) **Floodplains.** When disposing of excess, spoil, or other construction materials on public or private property, the Contractor shall not fill in or otherwise convert 100 year floodplain areas delineated on the latest Federal Emergency Management Agency (FEMA) Floodplain Maps, or other appropriate maps, i.e., alluvial soils on Natural Resource Conservation Service (NRCS) Soil Survey Maps.
- (3) **Endangered Species.** The Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of the Contractor, the Contractor will immediately report this evidence to the Owner and a representative of EDA. Construction shall be temporarily halted pending the notification process and further directions issued by EDA after consultation with the U.S. Fish and Wildlife Service.

27. **DEBARMENT, SUSPENSION, INELIGIBILITY, AND VOLUNTARY EXCLUSIONS**

As required by Executive Orders 12549 and 12689, *Debarment and Suspension*, 2 C.F.R. Part 180 and implemented by the Department of Commerce at 2 C.F.R. part 1326, for prospective participants in lower tier covered transactions (except subcontracts for goods or services under the \$25,000 small purchase threshold unless the subrecipient will have a critical influence on or substantive control over the award), the Contractor agrees that:

- (1) By entering into this Contract, the Contractor and subcontractors certify, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared Economic Development Administration Contracting Provisions for Construction Projects

ineligible, or voluntarily excluded from participation in this Contract by any federal department or agency.

(2) Where the Contractor or subcontractors are unable to certify to any of the statements in this certification, the Contractor or subcontractors shall attach an explanation to this bid.

See also 2 C.F.R. part 180 and 2 C.F.R. § 200.342.

28. **EDA PROJECT SIGN**

The Contractor shall supply, erect, and maintain in good condition a Project sign according to the specifications provided by EDA. To the extent practical, the sign should be a free standing sign. Project signs shall not be located on public highway rights-of-way. Location and height of signs will be coordinated with the local agency responsible for highway or street safety in the Project area, if any possibility exists for obstructing vehicular traffic line of sight. Whenever the EDA site sign specifications conflict with State law or local ordinances, the EDA Regional Director will permit such conflicting specifications to be modified so as to comply with State law or local ordinance.

29. **BUY AMERICA**

To the greatest extent practicable, contractors are encouraged to purchase American-made equipment and products with funding provided under EDA financial assistance awards.

CERTIFICATION REGARDING LOBBYING LOWER TIER COVERED TRANSACTIONS

Applicants should review the instructions for certification included in the regulations before completing this form. Signature on this form provides for compliance with certification requirements under 15 CFR Part 28, "New Restrictions on Lobbying."

LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 15 CFR Part 28, for persons entering into a grant, cooperative agreement or contract over \$100,000 or a loan or loan guarantee over \$150,000 as defined at 15 CFR Part 28, Sections 28.105 and 28.110, the applicant certifies that to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure occurring on or before October 23, 1996, and of not less than \$11,000 and not more than \$110,000 for each such failure occurring after October 23, 1996.

Statement for Loan Guarantees and Loan Insurance

The undersigned states, to the best of his or her knowledge and belief, that:

In any funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this commitment providing for the United States to insure or guarantee a loan, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

Submission of this statement is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required statement shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure occurring on or before October 23, 1996, and of not less than \$11,000 and not more than \$110,000 for each such failure occurring after October 23, 1996.

As the duly authorized representative of the applicant, I hereby certify that the applicant will comply with the above applicable certification.

NAME OF APPLICANT

AWARD NUMBER AND/OR PROJECT NAME

PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE

SIGNATURE

DATE

**NOTICE OF REQUIREMENTS FOR AFFIRMATIVE ACTION
TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY
(EXECUTIVE ORDER 11246 AND 41 CFR PART 60-4)**

The following Notice shall be included in, and shall be a part of all solicitations for offers and bids on all Federal and federally assisted construction contracts or subcontracts in excess of \$10,000.

The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Timetables	Goals for minority participation for each trade	Goals for female participation for each trade
	%	6.9%

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is:

State of _____

County of _____

City of _____

EDA PROJECT SIGN

The Contractor shall supply, erect, and maintain in good condition a project sign according to the specifications set forth below:

EDA SITE SIGN SPECIFICATIONS

Size: 4' x 8' x ¾"

Materials: Exterior grade/MDO plywood (APA rating A-B)

Supports: 4" x 4" x 12' posts with 2" x 4" cross branching

Erection: Posts shall be set a minimum of three feet deep in concrete footings that are at least 12" in diameter.

Paint: Outdoor enamel

Colors: Jet Black, Blue (PMS300), and Gold (PMS7406). Specifically, on white background the following will be placed:

The U. S. Department of Commerce seal in blue, black, and gold;

“EDA” in blue;

“U. S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT

ADMINISTRATION” in black;

“In partnership with” in blue;

(Actual name of the) “EDA Grant Recipient” in black;

Lettering: Specific fonts are named below; positioning will be as shown on the attached illustration.

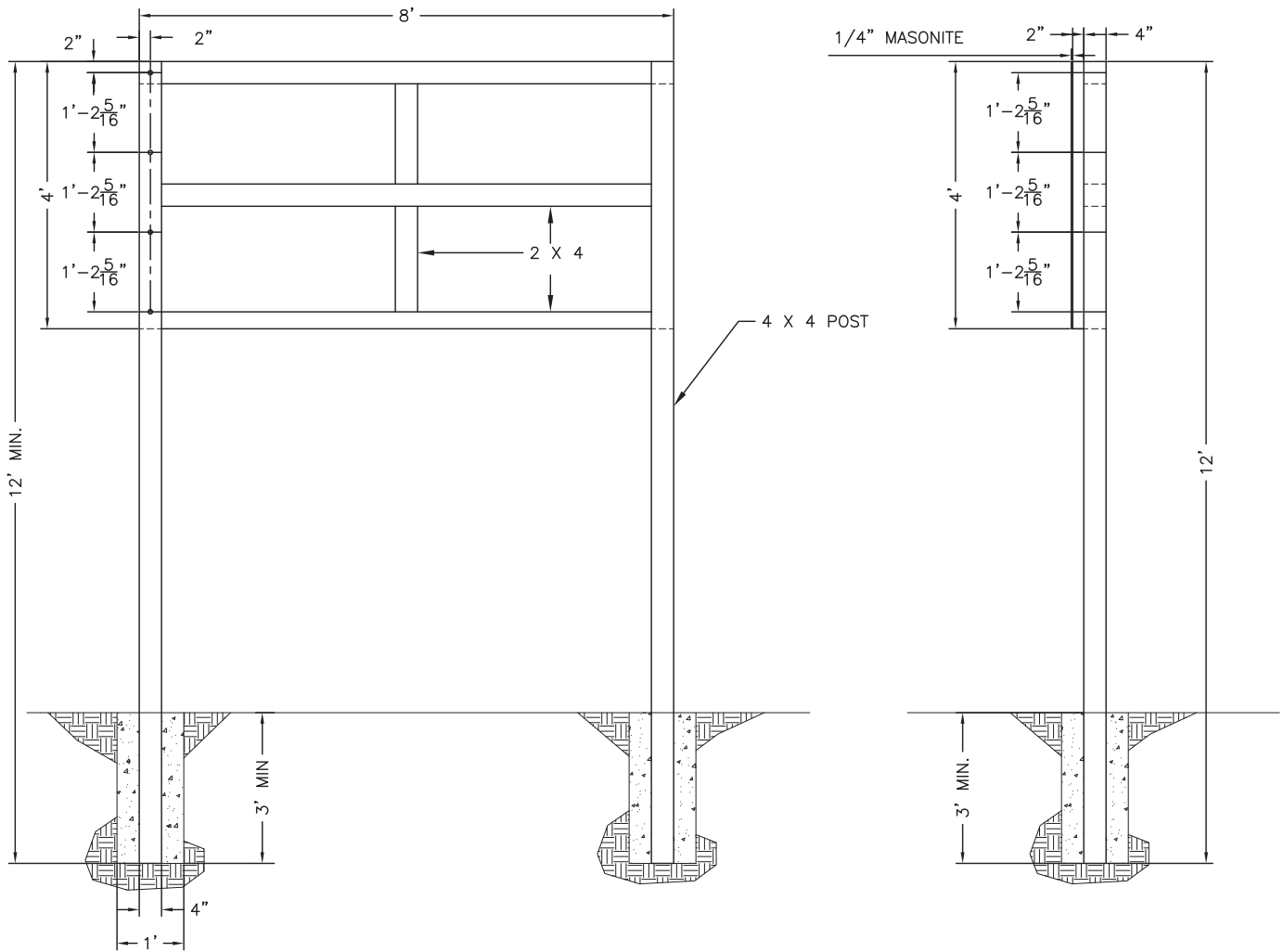
“U. S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT
ADMINISTRATION” use Bank Gothic Medium - **BANK GOTHIC MED**

“In partnership with” use Univers™ 55 Oblique - **Univers 55**

(Name of) “EDA Grant Recipient” use Univers™ Extra Black 85 **Univers 85**

Project signs will not be erected on public highway rights-of-way. If any possibility exists for obstruction to traffic line of sight, the location and height of the sign will be coordinated with the agency responsible for highway or street safety in the area.

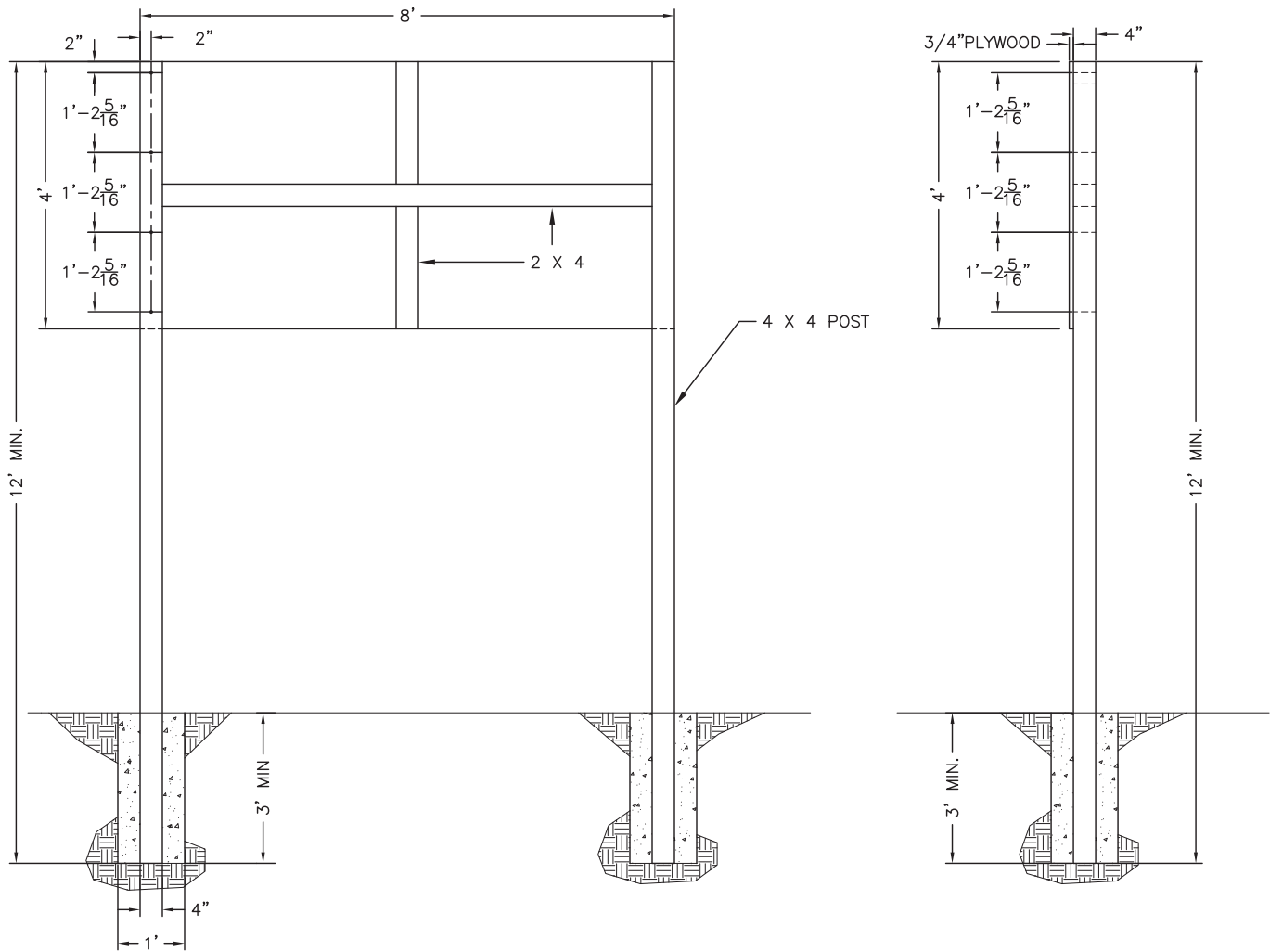
The EDA Regional Director may permit modifications to these specifications if they conflict with state law or local ordinances.



SIGN A
MASONITE SIGN
SCALE: 3/8" = 1'

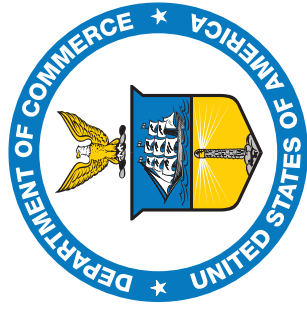
PROJECT - SIGN A

ECONOMIC DEVELOPMENT ADMINISTRATION



SIGN B
PLYWOOD SIGN
SCALE: 3/8" = 1'

PROJECT - SIGN B
ECONOMIC DEVELOPMENT ADMINISTRATION

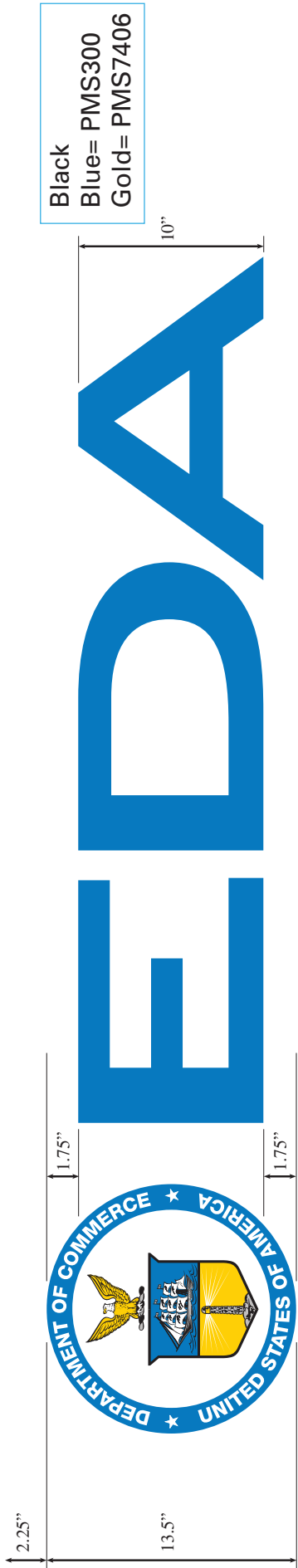


EDA

U.S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT ADMINISTRATION

In partnership with

<EDA Grant Recipient Name>



U.S. DEPARTMENT OF COMMERCE ECONOMIC DEVELOPMENT ADMINISTRATION

In partnership with

<EDA Grant Recipient Name>



"General Decision Number: NY20240019 01/05/2024

Superseded General Decision Number: NY20230019

State: New York

Construction Type: Building

County: Niagara County in New York.

BUILDING CONSTRUCTION PROJECTS (except single family homes and apartments up to and including 4 stories),

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

<p>If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:</p>	<p>. Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.</p>
<p>If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:</p>	<p>Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.</p>

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the

contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number Publication Date
 0 01/05/2024

ASBE0004-001 05/01/2023	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR (include application of all materials, protective coverings, coatings, and finishings to all types of mechanical systems).....	\$ 36.10	27.94
HAZARDOUS MATERIAL HANDLER.....	\$ 34.15	26.09
<hr/>		
BRNY0045-002 07/01/2020	Rates	Fringes
Bricklayer, Stonemason.....	\$ 31.72	29.18
Marble mason.....	\$ 32.25	28.15
Pointer, cleaner and caulker.....	\$ 31.72	29.18
Tile & Terrazzo Worker.....	\$ 32.25	28.15
Tile, Marble & Terrazzo Finisher.....	\$ 29.31	15.44
<hr/>		
CARP0276-016 07/01/2022	Rates	Fringes
Carpenters (Including Drywall Hanging & Acoustical Ceiling Installation) Carpenters and Soft Floor Layers.....	\$ 33.06	25.93
Millwrights.....	\$ 32.28	25.36
<hr/>		

ELEC0237-001 05/29/2023 Rates Fringes

Electricians:

Cable Splicers.....	\$ 37.40	27.44
Electricians.....	\$ 40.60	31.99

ELEV0014-001 01/01/2023 Rates Fringes

ELEVATOR MECHANIC.....\$ 57.37 37.335+a+b

FOOTNOTE:

- a. VACATION: 6%/under 5 years based on regular hourly rate for all hours worked. 8%/over 5 years based on regular hourly rate for all hours worked.
b. PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Veterans' Day; Thanksgiving Day; the Friday after Thanksgiving Day; and Christmas Day.
-

ENGI0017-010 07/01/2016 Rates Fringes

POWER EQUIPMENT OPERATOR

Backhoe Operators		
Group A1.....	\$ 36.37	27.10
Bulldozer		
Group A1.....	\$ 36.37	27.10
Forklift Operator/Lull		
Group A1.....	\$ 36.37	27.10
Loader		
Group A1.....	\$ 36.37	27.10
Roller		
Group A1.....	\$ 36.37	27.10

IRON0009-003 07/01/2023 Rates Fringes

Ironworkers:

IRONWORKER.....	\$ 33.00	31.00
SHEETER.....	\$ 33.00	31.00

LABO0091-001 07/01/2003 Rates Fringes

Laborers:

GROUP 1.....	\$ 32.45	41.36+a
GROUP 2.....	\$ 35.70	41.36+a
GROUP 3.....	\$ 33.45	41.36+a
GROUP 4.....	\$ 33.30	41.36+a
GROUP 5.....	\$ 33.05	41.36+a
GROUP 6.....	\$ 32.95	41.36+a
GROUP 7.....	\$ 32.75	41.36+a

GROUP 8.....	\$ 34.45	41.36+a
GROUP 9.....	\$ 37.45	41.36+a

LABORER CLASSIFICATIONS

GROUP 1: Common Laborers, Decontamination of all machines; Horizontal Directional Drill/Locator; All terrain vehicles with attachments/All wheel or track types

GROUP 2: Blasters, Grade Checker; 10% of Base Rate

GROUP 3: Wagon Drill-Airtrack, Self-Contained Drill

GROUP 4: Laser Beam Operator

GROUP 5: Road Finisher, Form Setter, Gunnite Nozzleman, Sandblasters, Burning Torch, Concrete Saw Operators, Grout Machine and Grout Pumps Operator

GROUP 6: Video Machine Operator in inspection of Pipe

GROUP 7: Potman, Pipelayers, Pavement Breakers or Busters, jackhammer operators; barco rammers; chain saw; powder monkey; black top rakers; scalers; drill tenders; mortar mixers; Concrete polishing machine; Operation & maintenance of all Robotic Remote Systems in hazardous environment; Peration C men working from swinging scaffold bosum chair; suspended cage or bucket; work in caissons below 8 feet; concrete motor buggy; all other operators of mechanical tools, including vibrators egardless of type of power.

GROUP 8: The handling, loading, unloading, stacking, distribution, erection and dismantling of any and all types of scaffolding and/or work platforms used in the removal of insulating material regardless of the composition of said material. The removal of all insulation materials whether they contain asbestos or not from mechanical systems, (pipes, boilers,ducts, flues, breechings, etc.) on all mechanical systems (pipes, boilers, ducts, flues, breeching, etc.) that are going to be scrapped. The removal of all insulating materials whether they contain asbestos or not. The removal of all asbestos containing materials from walls, ceilings, floors, columns and all other non-mechanical structures and surfaces, etc;

GROUP 9: Use of supplied air respirators

FOOTNOTE:

- a. PAID HOLIDAYS: Memorial Day, Labor Day, Thanksgiving Day
-

PAIN0004-010 05/01/2017

TOWNSHIPS OF LEWISTON, NIAGARA FALLS, PORTER, WHEATFIELD and the western halves of CAMBRIA and WILSON

	Rates	Fringes
Painters:		
Painters.....	\$ 25.95	23.69
Tapers/Dry Wall.....	\$ 26.45	23.69

PAIN0004-012 05/01/2023

	Rates	Fringes
GLAZIER.....	\$ 30.48	26.34

PLAS0111-003 07/01/2023

	Rates	Fringes
CEMENT FINISHER.....	\$ 32.45	34.17
PLASTERER.....	\$ 30.15	20.49

PLUM0022-005 05/01/2023

	Rates	Fringes
Plumber and Steamfitter		
ZONE 1.....	\$ 40.97	28.53

ROOF0074-002 06/01/2023

	Rates	Fringes
Roofers:		
Composition.....	\$ 32.96	24.87
Slate & Tile.....	\$ 33.11	24.87

SHEE0071-002 05/29/2023

	Rates	Fringes
Sheet metal worker.....	\$ 38.50	28.35

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on
- * a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Contractor's use of site and premises.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and Drawing conventions.
7. Time of Completion.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

- ##### A. Project Identification: Conversion of the existing church's basement and partial first floor spaces to new classrooms, break out rooms, and administrative offices for Niagara Universities' Work Force Development Training program. Renovations will include replacement and repair of windows, new HVAC systems (excluding the Sanctuary), new flooring, salvaging and reuse of wood doors, wood trims and mouldings. All work will be completed in conjunction with SHPO/NPS and historic standards and comply with the current building code of New York State.

1. Project Location: 822 Cleveland Avenue, Niagara Falls, New York, 14305.

- ##### B. Owner: Niagara University, 5795 Lewiston Road, Niagara Falls, New York, 14109.

1. Owner's Representative: Daniel McMann, Director of Facility Services, dmcman@niagara.edu, (716) 286-8755

- ##### C. Architect: LaBella Associates, DPC.

1. Architect's Representative: Joseph Rudniski, Project Manager, jrudniski@labellapc.com, (716) 931-6510.

- ##### D. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Interior: Refer to Summary above for interior work summary.
2. Exterior: The building will be cleaned and undergo extensive masonry repointing as necessary to stabilize the facades. New exterior windows and doors will be installed. The lower basement windows will receive decorative security grilles for security. The Sanctuary's stained glass windows will remain intact on all sides of the building and receive a new glass framed system for protection. All new landscaping, ramp connection from the public parking lot, rebuilt front stairs to the Sanctuary as well. Refer to the list of specifications and drawings located in the Project Manual's table of contents for drawings included in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.
2. Project will be constructed under a single prime contract using AIA Document A201-2017 General Conditions of the Contract for Construction.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- 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.

1.5 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with

completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1.6 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: Limit work in the existing building to normal business working hours of 7:00 a.m. to 3:30 p.m., Monday through Friday, unless otherwise indicated.
 - 1. Weekend Hours: To be coordinated with Construction Manager.
 - 2. Early morning and Second Shift Hours: To be submitted to the Construction Manager for approval.
 - 3. Hours for Utility Shutdowns: To be coordinate with Construction Manager.
- 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 Construction Manager not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Construction Manager not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Construction Manager's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site 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.

1.7 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. Interpretation of Drawings and Specifications

1. The lists of equipment, tabulations of data and schedules appearing in the specifications and/or drawings are included only for the assistance and guidance of the Contractor in arriving at a more complete understanding of the intended installation. They are not intended, or to be construed, as relieving the responsibility of the Contractors in making their own takeoffs.

C. Obstacles and Minor Adjustments – Mid-Course Adjustments

1. The Drawings are not intended to show all details relating to exact positioning and alignment of furnishings and components. The Contractor will be required to make such changes in location of furnishings and components as may be needed to accommodate the Work to obstacles encountered. Minor changes due to field conditions, or at the request of the Owner, shall be made by the Contractors at no expense to the Owner.

D. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

E. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

F. 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.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.8 TIME OF COMPLETION

- A. It is understood and mutually agreed that the time for Substantial Completion is an essential condition of this Contract.**

Academic Innovation Hub
Work Force Development Training
Niagara University

- B. Contractor agrees that work shall be prosecuted diligently and uninterruptedly at such rate as will insure Substantial Completion of all work and certificates of occupancy on or before the date stated in the Contract.
- C. It is expressly understood and agreed by Contractor and Owner that the time for Substantial Completion and certificates of occupancy are reasonable, taking into consideration average climatic range, restrictions concerning use of the site, and other conditions prevailing.
- D. Contractor shall schedule the Work accordingly. Second Shift and Weekend Shifts should be included to complete the work where disturbance to neighboring residence will not be disturbed and in accordance with this document.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - 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.

1.2 SELECTION AND PURCHASE

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

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

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

1.5 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.6 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Contingency Allowance: Include a contingency allowance of \$20,000.00 for any additional repointing to the existing church masonry required above and beyond what is specified in the contract documents.
 - 1. This allowance includes material, receiving, handling, and installation costs, and Contractor overhead and profit.

END OF SECTION 012100

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents 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.
 - 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.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form acceptable to Architect.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 15 days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days from the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.

- j. 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.

END OF SECTION 012500

SECTION 012600 - 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 through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.
 - 1. Work Change Proposal Requests issued by Construction Manager are not instructions either to stop work in progress or to execute the proposed change.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Construction Manager 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 Construction Manager 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.
- 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

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

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

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Construction Manager 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.

1.6 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Construction Manager may issue a Work Change Directive on EJCDC Document C-940. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Work 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 Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 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 through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- 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. Arrange schedule of values consistent with format of AIA Document G703.
 - 2. 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 ten percent of the Contract Sum.
 - 3. 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.
 - 4. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 - 5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
 - 6. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 - 7. 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.

1.3 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 Construction Manager and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
 - 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. Construction Manager 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. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from 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. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.

3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Sustainable design action plans, including preliminary project materials cost data.
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
 14. Certificates of insurance and insurance policies.
 15. Performance and payment bonds.
 16. Data needed to acquire Owner's insurance.
- H. 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.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. 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. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706.
 5. AIA Document G706A.
 6. AIA Document G707.
 7. Evidence that claims have been settled.
 8. 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.
 9. Final liquidated damages settlement statement.

END OF SECTION 012900

SECTION 013000 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Preinstallation meetings.
- F. Closeout meeting.
- G. Alteration procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements with provisions for accommodating items installed later.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practical; place runs parallel with lines of building. Use spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
 - 1. Coordination Drawings: Prepare as required to coordinate all portions of Work. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important.
- D. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

1.3 PRECONSTRUCTION MEETING

- A. Architect/Engineer and Owner will schedule and preside over meeting after Notice of Award.
- B. Attendance Required: Architect/Engineer, Owner, Construction Manager, and major Subcontractors, and Contractors.
- C. Minimum Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of Subcontractors, list of products, schedule of values, and Progress Schedule.
 - 5. Designation of personnel representing parties in Contract, and Architect/Engineer.
 - 6. Communication procedures.
 - 7. Procedures and processing of requests for interpretations, field decisions, field orders, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
 - 8. Scheduling.
 - 9. Critical Work sequencing.
- D. Construction Manager: Record minutes and distribute electronic copies to participants within two days after meeting, including Architect/Engineer, Owner, and those affected by decisions made.

1.4 SITE MOBILIZATION MEETING

- A. Architect/Engineer and Owner will schedule meeting at Project Site prior to Contractor occupancy. Construction Manager presides over meeting.
- B. Attendance Required: Architect/Engineer, Owner, Contractor, Contractor's Superintendent, Construction Manager, major Contractors and major Subcontractors.
- C. Minimum Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements and partial occupancy.
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Survey and building layout.
 - 6. Security and housekeeping procedures.
 - 7. Schedules.
 - 8. Procedures for testing.
 - 9. Procedures for maintaining record documents.
 - 10. Requirements for startup of equipment.
 - 11. Inspection and acceptance of equipment put into service during construction period.

- D. Construction Manager: Record minutes and distribute electronic copies to participants within two days after meeting, to Architect/Engineer, Owner, and those affected by decisions made.

1.5 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at intervals determined at Pre-Construction Meeting.
- B. The Construction Manager will make arrangements for meetings, prepare agenda with copies for participants, and preside over meetings.
- C. Attendance Required: Job superintendent, major Subcontractors Contractors and suppliers, and Architect/Engineer, Owner, as appropriate to agenda topics for each meeting.
- D. Minimum Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems impeding planned progress.
 - 5. Review of submittal schedule and status of submittals.
 - 6. Review of off-site fabrication and delivery schedules.
 - 7. Maintenance of Progress Schedule.
 - 8. Corrective measures to regain projected schedules.
 - 9. Planned progress during succeeding work period.
 - 10. Coordination of projected progress.
 - 11. Maintenance of quality and work standards.
 - 12. Effect of proposed changes on Progress Schedule and coordination.
 - 13. Other business relating to Work.
- E. Construction Manager: Record minutes and distribute electronic copies to participants within two days after meeting, to Architect/Engineer, Owner, and those affected by decisions made.

1.6 PREINSTALLATION MEETINGS

- A. When required in individual Specification Sections, convene preinstallation meetings at Project Site before starting Work of specific Section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific Section.
- C. Notify Architect/Engineer four days in advance of meeting date.
- D. Prepare agenda and preside over meeting:
 - 1. Review conditions of installation, preparation, and installation procedures.
 - 2. Review coordination with related Work.

- E. Construction Manager: Record minutes and distribute electronic copies to participants within two days after meeting, to Architect/Engineer, Owner, and those affected by decisions made.

1.7 CLOSEOUT MEETING

- A. Schedule Project closeout meeting with sufficient time to prepare for requesting Substantial Completion. Preside over meeting and be responsible for minutes.
- B. Attendance Required: Construction Manager, major Contractors, major Subcontractors, Architect/Engineer, Owner, and others appropriate to agenda.
- C. Notify Architect/Engineer four days in advance of meeting date.
- D. Minimum Agenda:
 - 1. Start-up of facilities and systems.
 - 2. Operations and maintenance manuals.
 - 3. Testing, adjusting, and balancing.
 - 4. System demonstration and observation.
 - 5. Operation and maintenance instructions for Owner's personnel.
 - 6. Temporary indoor-air-quality plan and procedures.
 - 7. Contractor's inspection of Work.
 - 8. Contractor's preparation of an initial "punch list."
 - 9. Procedure to request Architect/Engineer inspection to determine date of Substantial Completion.
 - 10. Completion time for correcting deficiencies.
 - 11. Inspections by authorities having jurisdiction.
 - 12. Certificate of Occupancy and transfer of insurance responsibilities.
 - 13. Partial release of retainage.
 - 14. Final cleaning.
 - 15. Preparation for final inspection.
 - 16. Closeout Submittals:
 - a. Project record documents.
 - b. Operating and maintenance documents.
 - c. Operating and maintenance materials.
 - d. Affidavits.
 - 17. Final Application for Payment.
 - 18. Contractor's demobilization of Site.
 - 19. Maintenance.
- E. Construction Manager: Record minutes and distribute electronic copies to participants within two days after meeting, to Architect/Engineer, Owner, and those affected by decisions made.

PART 2 - EXECUTION

2.1 ALTERATION PROCEDURES

- A. Areas designated by the Owner may be occupied for normal operations during progress of construction. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage.
 - 1. Perform Work not to interfere with operations of occupied areas.
 - 2. Keep utility and service outages to a minimum and perform only after written approval of Owner.
 - 3. Clean Owner-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.
- B. Materials: As specified in product Sections; match existing products with new and salvaged products for patching and extending Work.
- C. Employ original installer to perform alteration and renovation Work.
- D. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- E. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- F. Remove debris and abandoned items from area and from concealed spaces.
- G. Prepare surface and remove surface finishes to permit installation of new Work and finishes.
- H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.
- I. Remove, cut, and patch Work to minimize damage and to permit restoring products and finishes to specified condition.
- J. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with neat transition to adjacent finishes.
- K. Where new Work abuts or aligns with existing Work, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- L. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.
- M. Where change of plane of 1/4 or more occurs, submit recommendation for providing smooth transition to Architect/Engineer for review.
- N. Trim existing doors to clear new floor finish. Refinish trim to renewed condition.

- O. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- P. Finish surfaces as specified in individual product Sections.

END OF SECTION 013000

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
1. General coordination procedures.
 2. Coordination drawings.
 3. RFIs.
 4. Digital project management procedures.
 5. Project meetings.
- B. Related Requirements:
1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 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.

1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to 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.

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

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door

floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. 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.

1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 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. Owner name.
 2. Owner's Project number.
 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 suggested resolution 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.
- C. RFI Forms: Form bound in Project Manual. An editable version of the document will be provided by the Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will 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 by Architect 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 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.

1.6 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
- 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. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.

- o. Use of the premises and existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for disruptions and shutdowns.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Progress Meetings: Conduct progress meetings at biweekly 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) Sequence of operations.
 - 2) Status of submittals.
 - 3) Deliveries.
 - 4) Off-site fabrication.
 - 5) Access.
 - 6) Site use.
 - 7) Temporary facilities and controls.
 - 8) Progress cleaning.
 - 9) Quality and work standards.
 - 10) Status of correction of deficient items.
 - 11) Field observations.
 - 12) Status of RFIs.

- 13) Status of Proposal Requests.
 - 14) Pending changes.
 - 15) Status of Change Orders.
 - 16) Pending claims and disputes.
 - 17) 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

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 Construction Manager and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Refer to Exhibit following this specification section.
- 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 and Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 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 unsuitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, 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. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
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(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.
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 one set of samples which the architect will retain.
 - 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 one set 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:
- 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 Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 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 and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

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 and Construction Manager.
- 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 and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S AND CONSTRUCTION MANAGER'S REVIEW

- A. Action Submittals: Architect and Construction Manager will review each submittal, indicate corrections or revisions required, and return it.
 - 1. PDF Submittals: Architect and Construction Manager will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.

- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect and Construction Manager will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

END OF SECTION 013300

EDA Project No. 01-01-15369
HUD Project No. B-23-CP-NY-1083
ESD Project No. 135.035

SUBMITTAL COVER SHEET

DATE:

PROJECT NAME: Niagara University Academic Innovation Hub Work Force Development Training		
<i>Specification Section</i>	<i>Submittal #</i>	<i>Rev.#</i>

Project Information:

OWNER: Niagara University 11 Vincentian Drive, P.O. Box 2033 Niagara Falls, New York 14109	ARCHITECT: LaBella Associates, D.P.C. 300 Pearl Street, Suite 130 Buffalo, New York 14202	CONTRACTOR:
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Submittal Information:

SUBMITTAL NAME/DESCRIPTION:				CONTRACTOR SUBMITTAL #:	SUBCONTRACTOR:
SPECIFICATION:	PARAGRAPH:	DRAWING:	DETAIL:	SUPPLIER:	SUBSTITUTION:
ACTION / INFORMATIONAL SUBMITTALS:			RECORD SUBMITTAL:		
<input type="checkbox"/> Product Data	<input type="checkbox"/> Qualification Data	<input type="checkbox"/> Field Test Report		<input type="checkbox"/> Warranty	
<input type="checkbox"/> Shop Drawing	<input type="checkbox"/> Certificates	<input type="checkbox"/> Operation/Maintenance Data		<input type="checkbox"/> Attic Stock / Turnover	
<input type="checkbox"/> Sample	<input type="checkbox"/> Warranty Sample	<input type="checkbox"/> As-built Drawing		<input type="checkbox"/> Other: _____	
<input type="checkbox"/> Coordination Drawing	<input type="checkbox"/> Other: _____				

<p>Contractor Review: <i>This submittal has been reviewed, checked and approved for compliance with the Contract Documents. Any substitutions / deviations are noted below.</i></p> <p>Signed: _____ Dated: _____</p>	<p>Construction Manager Review: <i>This submittal has been received for coordination. Any observations noted below do not replace final review and acceptance by the Architect/Engineer of record.</i></p> <p>Signed: _____ Dated: _____</p>
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<p>Architect/Engineer Review:</p> <p><input type="checkbox"/> Reviewed <input type="checkbox"/> Revise and Resubmit <input type="checkbox"/> Rejected <input type="checkbox"/> Furnish as Noted</p> <p>Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.</p> <p style="text-align: center;">LaBella Associates, D.P.C.</p> <p>Signed: _____ Dated: _____</p>	<p>Architect/Engineer Comments:</p> <p> </p>
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SECTION 013591 - HISTORIC TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general protection and treatment procedures for designated historic spaces, areas, rooms, and surfaces in Project.

1.2 DEFINITIONS

- A. Consolidate: To strengthen loose or deteriorated materials in place.
- B. Design Reference Sample: A sample that represents Architect's prebid selection of work to be matched; it may be existing work or work specially produced for Project.
- C. Dismantle: To disassemble or detach a historic item from a surface, or a non-historic item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- D. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- E. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- F. Reinstall: To protect removed or dismantled item, repair and clean it as indicated for reuse, and reinstall it in original position, or where indicated.
- G. Remove: To take down or detach a non-historic item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- H. Repair: To correct damage and defects, retaining existing materials, features, and finishes while employing as little new material as possible. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- I. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- J. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- K. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

- L. Restore: To consolidate, replicate, reproduce, repair, and refinish as required to achieve the indicated results.
- M. Retain: To keep an element or detail secure and intact.
- N. Reversible: New construction work, treatments, or processes that can be removed or undone in the future without damaging historic materials unless otherwise indicated.
- O. Salvage: To protect removed or dismantled items and deliver them to Owner ready for reuse.
- P. Stabilize: To provide structural reinforcement of unsafe or deteriorated items while maintaining the essential form as it exists at present; also, to reestablish a weather-resistant enclosure.
- Q. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 PROJECT MEETINGS FOR HISTORIC TREATMENT

- A. Preliminary Historic Treatment Conference: Before starting historic treatment work, Architect will conduct conference at Project site.
 - 1. Attendees: In addition to representatives of Owner, Construction Manager, Architect, and Contractor, testing service representative, historic treatment specialists, chemical-cleaner manufacturer(s), and installers whose work interfaces with or affects historic treatment shall be represented at the meeting.
 - 2. Agenda: Discuss items of significance that could affect progress of historic treatment work, including review of the following:
 - a. Fire-prevention plan.
 - b. Governing regulations.
 - c. Areas where existing construction is to remain and the required protection.
 - d. Hauling routes.
 - e. Sequence of historic treatment work operations.
 - f. Storage, protection, and accounting for salvaged and specially fabricated items.
 - g. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - 3. Reporting: Architect will record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct specifically for historic treatment work at monthly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 - 1. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of historic treatment work. Include topics for discussion as appropriate to status of Project.
 - 2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1.5 INFORMATIONAL SUBMITTALS

- A. Historic Treatment Program: Submit 30 days before work begins.
- B. Fire-Prevention Plan: Submit 30 days before work begins.

1.6 QUALITY ASSURANCE

- A. Historic Treatment Program: Prepare a written plan for historic treatment for whole Project, including each phase or process and protection of surrounding materials during operations. Describe in detail the materials, methods, and equipment to be used for each phase of work. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project historic treatment program with specific requirements of programs required in other historic treatment Sections.
 - 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- B. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- C. Safety and Health Standard: ANSI/ASSP A10.6.

1.7 STORAGE AND HANDLING OF HISTORIC MATERIALS

- A. Identification: Photograph, tag, and catalog historic items to be salvaged or reinstalled.
 - 1. Identify each item with a nonpermanent location identification tag indicating item name or use, location, and location identification number to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying tag.
 - a. For groups of material such as brick, provide location identification tag for pallet or container. Do not tag individually.

B. Salvaged Historic Materials:

1. Clean loose dirt and debris from salvaged historic items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Historic Materials for Reinstallation:

1. Repair and clean historic items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

D. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after historic treatment and construction work in the vicinity is complete.

E. Storage: Store historic items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Secure stored materials to protect from theft.
2. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from historic treatment procedures.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where historic treatment work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.

4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during historic treatment work.
5. Contain dust and debris generated by historic treatment work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.

B. Temporary Protection of Historic Materials:

1. Protect existing historic materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to historic surfaces except as indicated as part of the historic treatment program and approved by Architect.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by historic treatment work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for historic treatment work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.

1. Prevent solids such as stone or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from historic treatment work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

3.2 PROTECTION FROM FIRE

A. Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.

- a. If combustible material cannot be removed, provide fire blankets to cover such materials.
3. Prohibit smoking by all persons within Project work and staging areas.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
 1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Use of open-flame equipment is not permitted. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
 2. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that area is safe.
 3. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 4. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 5. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would distract from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for type of fire risk in each work area. Ensure that nearby personnel and fire-watch personnel are trained in fire-extinguisher and blanket use.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in historic treatment program. Use covering materials and masking agents that are waterproof and UV

resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL HISTORIC TREATMENT

- A. Have historic treatment work performed only by qualified historic treatment specialists.
- B. Ensure that supervisory personnel are present when historic treatment work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs or video recordings.
- D. Perform **regular** inspections of Project site as the Work progresses to detect hazards resulting from historic treatment procedures.
- E. Follow the procedures in subparagraphs below and procedures approved in historic treatment program unless otherwise indicated:
 - 1. Retain as much existing material as possible; repair and consolidate rather than replace.
 - 2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
 - 3. Use reversible processes wherever possible.
 - 4. Use historically accurate repair and replacement materials and techniques unless otherwise indicated.
 - 5. Record existing work before each procedure (preconstruction) and progress during the work with digital preconstruction documentation photographs or video recordings.
- F. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.
- G. Where missing features are indicated to be repaired or replaced, provide work with appearance based on accurate duplications rather than on conjecture, subject to approval of Architect.
- H. Where work requires existing features to be removed or dismantled and reinstalled, perform these operations without damage to the material itself, to adjacent materials, or to the substrate.

- I. Identify new and replacement materials and features with permanent marks hidden in the completed Work to distinguish them from original materials. Record a legend of identification marks and the locations of the items on record Drawings.

END OF SECTION 013591

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. 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.
 - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, Construction Manager, 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) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
 - G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
 - H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
 - I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
 - J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect[**or Construction Manager**].

1.3 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. **Contractor's Statement of Responsibility:** When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. **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.
- C. **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. Statement on condition of substrates and their acceptability for installation of product.
2. Statement that products at Project site comply with requirements.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. 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. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. 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 be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor Responsibilities:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, through Construction Manager, 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.
3. Notify Architect and Construction Manager, seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers that 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 and Construction Manager'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.

1.8 QUALITY CONTROL

- A. 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. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 72 hours in advance of time when Work that requires testing or inspection will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- B. 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.
- C. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, , Construction Manager, 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.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- E. 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.
- F. 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. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- 1.9 SPECIAL TESTS AND INSPECTIONS
- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of

Owner, as indicated in the Statement of Special Inspections within the drawing set 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, Commissioning Authority, , Construction Manager, 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 and Commissioning Authority, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - EXECUTION

2.1 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, Commissioning Authority's, and Construction Manager's and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

2.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

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

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "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 should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to 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. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. AABC - Associated Air Balance Council; www.aabc.com.
 2. AAMA - American Architectural Manufacturers Association; (see FGIA).
 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 8. ACI - American Concrete Institute; www.concrete.org.
 9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
 10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
 11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 12. AF&PA - American Forest & Paper Association; www.afandpa.org.
 13. AGA - American Gas Association; www.aga.org.
 14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 16. AI - Asphalt Institute; www.asphaltinstitute.org.
 17. AIA - American Institute of Architects (The); www.aia.org.
 18. AISC - American Institute of Steel Construction; www.aisc.org.
 19. AISI - American Iron and Steel Institute; www.steel.org.
 20. AITC - American Institute of Timber Construction; (see PLIB).
 21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
 23. ANSI - American National Standards Institute; www.ansi.org.
 24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.

25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; American Society of Mechanical Engineers (The); www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CE - Conformance Européenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.

67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridarooft.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.
96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.
109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.

112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.
120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
121. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; www.nadca.com.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association; www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.
141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.

156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; www.securityindustry.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steel tank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
185. TMS - The Masonry Society; www.masonrysociety.org.
186. TPI - Truss Plate Institute; www.tpinst.org.
187. TPI - Turfgrass Producers International; www.turfgrasssod.org.
188. TRI - Tile Roofing Industry Alliance; www.tilerroofing.org.
189. UL - Underwriters Laboratories Inc.; www.ul.org.
190. UL LLC - UL LLC; www.ul.com.
191. USAV - USA Volleyball; www.usavolleyball.org.
192. USGBC - U.S. Green Building Council; www.usgbc.org.
193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
194. WA - Wallcoverings Association; www.wallcoverings.org.
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
198. WI - Woodwork Institute; www.woodworkinstitute.com.
199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
200. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to 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 für 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.

Retain "Federal Government Agencies" Paragraph below if required. The Section Text in MasterSpec Sections is prepared assuming list is retained.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to 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. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to 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 U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.

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.dsp.dla.mil/Specs-Standards/.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from U.S. 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).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities 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. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
 2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
 3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; <https://fsweb.tamu.edu/>.

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer 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: 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.

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, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Accessible Temporary Egress: Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 4. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- B. Contractor trailers are not allowed.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to private system indicated as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
- I. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 - 1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 - 2. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Utilize designated area within existing building for temporary field offices.
 - 2. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Use designated areas of Owner's existing parking areas for construction personnel. Majority of parking will be on the street. Coordinate with superintendent.
- D. Storage and Staging: Use designated areas of Project site for storage and staging needs. Staging will be limited space at each end of the building. Long term storage is not available on site. Gang boxes can be set up in designated rooms during construction. Some may be located in the gym.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs so they are legible at all times.
 - 4. No Contractor signs are permitted on site or attached to Construction trailers or storage units except as required by contract.
- G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- H. 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 017300 "Execution."
- I. 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.

- J. Temporary Elevator Use: Use of elevators is not permitted.
- K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, in accordance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

- F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- K. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard and replace stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

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 that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused 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 by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- 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; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 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.

1.4 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.

1.5 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.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 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.

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. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- 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's 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's convenience will not be considered unless otherwise indicated.
 - 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 unless otherwise indicated.
 - 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. 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 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
 - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. 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.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 - 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
 - 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation.
 - 3. Cutting and patching.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.

- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 3. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

- A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 QUALITY ASSURANCE

- A. 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.
3. **Other Construction Elements:** Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. **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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. **In-Place Materials:** Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. **Cleaning Agents:** Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. **Existing Conditions:** The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate

and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect through Construction Manager in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. Use the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

3.4 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.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.

- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

- a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 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 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 02 Section "Selective Structure Demolition" for demolition of selected portions of the building.
 - 2. Divisions 02 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - 3. Division 07 Section "Penetration Firestopping" for patching fire-rated construction.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

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

and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Project Coordinator's/Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:
 1. Primary operational systems and equipment.
 2. Air or smoke barriers.
 3. Fire-suppression systems.
 4. Mechanical systems piping and ducts.
 5. Control systems.
 6. Communication systems.
 7. Conveying systems.
 8. Electrical wiring systems.
 9. Operating systems of special construction in Division 13 Sections.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
 1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain-wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential

interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize or prevent interruption to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. 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.
 5. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even

surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

- a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or re-hang 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 weather-tight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordination of responsibilities for waste management.
 - 2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
 - 3. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.4 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Comply with requirements in Section 024119 "Selective Demolition."
- B. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013000 "Project Meetings."

1.5 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.
- C. Waste Management in Historic Zones or Areas: Transportation equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches (300 mm) or more.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for Sale and Donation: Permitted on Project site.

D. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.
 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Grind asphalt to maximum 4-inch (100-mm) size.
- B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 1. Pulverize concrete to maximum 4-inch (100-mm) size.

- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum 1-1/2-inch (38-mm) size.
 - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- F. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- J. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- K. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- L. Carpet Tile: Remove debris, trash, and adhesive.
 - 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- M. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- N. Conduit: Reduce conduit to straight lengths and store by material and size.
- O. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.

2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
- D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

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

END OF SECTION 017419

SECTION 017700 - 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. List of incomplete items.
 - 4. Submittal of Project warranties.
 - 5. Final cleaning.

- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 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.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

1.4 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, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - 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 017900 "Demonstration and Training."
 - 6. Advise Owner of changeover in utility services.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements.
 - 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

Revise "Inspection" Paragraph below to comply with office policy and Project requirements.

- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 15 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of 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.

1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. 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 will state that each item has been completed or otherwise resolved for acceptance.
 2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 3. 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 and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.6 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 listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Construction Manager.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF Electronic File: Architect, through Construction Manager, will return annotated file.

1.7 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. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to Architect.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. 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. 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.

- c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- d. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
- e. Vacuum and mop concrete.
- f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
- g. 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.
- h. Remove labels that are not permanent.
- i. Wipe surfaces of mechanical and electrical equipment[, **elevator equipment**,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- l. 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.
- m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- n. Clean strainers.
- o. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls." And Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
1. Operation and maintenance documentation directory manuals.
 2. Emergency manuals.
 3. Systems and equipment operation manuals.
 4. Systems and equipment maintenance manuals.
 5. Product maintenance manuals.

1.2 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. Owner will comment on whether content of operation and maintenance submittals is acceptable.
 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
- C. 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. Owner 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.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.4 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 Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- 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."

1.5 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.

1.6 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.

- 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.

1.7 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.
- 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. 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.
- D. 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.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. 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.

H. 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.

1.8 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. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit two set(s) of marked-up record prints.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

- E. Reports: Submit written report indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
- B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file.
 - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - 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.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and 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.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.5 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.

1.6 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.

1.7 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 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. 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 with at least seven days' advance notice.
- D. 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.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. 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

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 020800 – ASBESTOS REMOVAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Work of this Section shall be performed in accordance with the requirements of the Contract Documents, including but not limited to Instructions to Bidders, Agreement and General Conditions and General Requirements.
- B. This Section references procedures for the removal of existing asbestos-containing materials (ACM) that will be disturbed or are disturbed during construction of this project.
- C. Furnish all labor, materials, supervision, construction tools and equipment necessary to remove and dispose of **all asbestos-containing materials** disturbed during construction.

An asbestos inspection report titled “Pre-Renovation Asbestos, Lead-Based Paint and PCB Inspection” dated April 23, 2020, prepared by Stohl Environmental can be found in Appendix A of the bid documents / project manual. This report incorporates and includes all testing data obtained for the site, based on project scope and materials reported to be disturbed by planned renovations. See the attached report for detailed descriptions of the types of ACM identified and the locations.

The asbestos-containing materials identified at the site are listed below:

- 1. 12” x 12” Floor Tile - Red
 - 2. 12” x 12” Floor Tile - Yellow
 - 3. Linoleum Green Square Pattern
 - 4. Linoleum Flower Pattern Square
 - 5. Linoleum Mastic - Yellow
 - 6. Linoleum Brick Pattern
 - 7. Mudded Pipe Elbow Insulation
 - 8. Asbestos Pipe Insulation
 - 9. Sink Insulation
 - 10. Electrical Panel Heat Shield
 - 11. Fire Door Insulation
 - 12. 1850's Window Caulk
 - 13. 1850's Window Glazing
 - 14. Addition Roof– Field Felt, Flashing Felts, Repair Tar
- D. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed referenced in the Contract Documents. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.
 - E. Removal or disturbance of ACM shall be completed in compliance with all governing regulations, including Code Rule 56. Any Contractor, other than the asbestos abatement contractor, who requires the removal or disturbance of asbestos-containing material (ACM) to complete his work shall obtain the services of a certified asbestos abatement contractor to remove the ACM in compliance with this specification and all applicable rules and regulations.

- F. The Owner's Representative shall approve the asbestos abatement contractor prior to the beginning of the work.
- G. Working hours shall be as required and approved by the Owner. The Contractor shall coordinate and schedule all Work with the facility and Owner's representative.
- H. Locations and quantities of all materials to be removed by the abatement contractor must be field verified. Information given on drawings and in the specifications is for general orientation and information only.
- I. The contractor shall have at least one supervisor on the job site at all times who can read and write and is fluent in English, while the project is in progress. The supervisor must be able to communicate fluently with all employees.
- J. Contractor shall provide temporary protection to keep the work areas enclosed, where required, during the performance of the Contract Work. The Contractor shall be responsible for any damage caused as a result of improper temporary protection.
- K. The Contractor is responsible for keeping the work area in a clean and safe condition at all times.
- L. Contractor is to coordinate with other trades on the job concerning scheduling, phasing, etc.

1.2 SUMMARY

- A. Any special job conditions, including variances obtained by the Owner, are described below.
 - No Variance Petitions have been submitted to date.

1.3 CODES AND REGULATIONS

- A. General Applicability of Codes and Regulations and Standards: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable codes, regulations and standards have the same force and effect (and are made a part of the Contract Documents by reference) as if copied directly into the Contract Documents, or as if published copies are bound herewith.
- B. Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all applicable Federal, State and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State and local regulations. The contractor shall hold the Owner and Owner's Representative harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees or his subcontractors.
- C. Federal Requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

OSHA: U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), including but not limited to:

Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules Title 29, Part 1926, Section 1101 of the Code of Federal Regulations

Respiratory Protection
Title 29, Part 1910, Section 134 of the Code of Federal Regulations

Access to Employee Exposure and Medical Records
Title 29, Part 1910, Section 2 of the Code of Federal Regulations

Hazard Communication
Title 29, Part 1910, Section 1200 of the Code of Federal Regulations

DOT: U.S. Department of Transportation, including but not limited to:

Hazardous Substances
Title 29, Part 171 and 172 of the Code of Federal Regulations

EPA: U.S. Environmental Protection Agency (EPA), including but not limited to:

National Emission Standard for Hazardous Air Pollutants (NESHAPS)
National Emission Standard for Asbestos
Title 40, Part 61, Subpart A, and revised Subpart M (Revised Subpart B) of the Code of Federal Regulations dated November 20, 1990

- D. State Requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials include but are not limited to the following:

New York State Department of Labor (NYSDOL) 12 NYCCR Part 56, as amended March 21, 2007. Also known as Industrial Code Rule 56 (ICR 56).

New York State Department of Environmental Conservation (DEC) Regulations regarding waste collector registration Title 6, Part 364 of the New York State Official compilation of Codes, Rules and Regulations. An annual "Industrial Waste Hauler Permit" specifically for asbestos-containing materials is required for transportation of asbestos-containing waste to the disposal site.

- E. Local Requirements: Abide by all local requirements which govern asbestos abatement work or hauling and disposal of asbestos waste materials.

1.4 SUBMITTALS

- A. Prior to commencement of any work (minimum of seven days prior to starting work) involving the disturbance of ACM, the Contractor shall submit the following to the Owner's Representative for review and approval:
1. Copy of current NYSDOL Asbestos Contractor's License (DOH-432)
 2. Copies of current worker's Asbestos Handler's Certificates
 3. Provide a statement signed by an authorized representative of the company stating that the Building Occupants/Other Trades notification required by ICR 56 will be or has been posted

- at least 10 days prior to the start of abatement. Provide a copy of the notification that will be posted at the job site
4. Copies of all proposed site-specific variances
 5. Copies of Project Notifications and proof of submittal (e.g. certified mail receipt) to NYS DOL and USEPA
 6. Copy of NYS DEC permit for waste hauler
 7. Name and address of landfill where asbestos-containing waste materials are to be buried. Include contact person and telephone number, and NYS DEC Part 360 permit number or other applicable permits
 8. Site-specific work plan in accordance with Section 1.5 D
 9. On a weekly basis, submit copies of all waste shipment records and disposal site receipts to the Owner
- B. During the project, legible copies of the following items must be submitted to the Owner's Representative (LaBella Associates, P.C.). If personnel records are not available at this time, workers will not be able to work on-site until copies are provided:
1. NYS DOL Asbestos Handling Certificates (DOH 442) for all persons employed on the project
 2. Project Log Book entries
 3. Any and all changes to the Contract, should any occur
 4. Personal sampling results within 24 hours of sampling
- C. Upon completion of the project, legible copies of the following items must be submitted to the Owner's Representative (LaBella Associates, P.C.):
1. Waste manifests, shipment records, and landfill receipts signed by the landfill operator submitted within 30 days after the waste leaves the site. A percentage of the final payment will be withheld until the Owner or Owner's Representative receives the waste shipment record.

1.5 QUALITY ASSURANCE

- A. Comply with the most recent edition of compilation of Codes, Rules and Regulations of the State of New York (Statutory Authority: Labor Law Section 906), including Rule 56 of Title 12 NYCRR, New York State, Department of labor, most currently amended (hereinafter referred to in this Specification as Code Rule 56). Note: Article 30 of the Labor Law sets forth procedures and standards that must be met by parties who desire to obtain variations of any of the requirements of this rule.
- B. Comply with all current and appropriate Federal, State and Local rules and regulations regarding work of this section, including those of the following agencies:
- New York State Uniform Fire Prevention and Building Code
 - New York State Department of Labor
 - New York State Department of Environmental Conservation (DEC)
 - Occupational Safety and Health Administration (OSHA)
 - United States Environmental Protection Agency (EPA)

- C. **Pre-Work Conference:** Before the work of this section is scheduled to commence, a conference may be held at the site for the purpose of reviewing the Contract Documents, discussing requirements for the work and reviewing the work procedures. The conference shall be attended by the asbestos abatement contractor.
- D. **Work Plan:** The Contractor shall prepare a detailed work plan and submit the plan no later than one week prior to the start of the abatement project. The work plan shall include, but not be limited to:
1. A preliminary schedule for completion of the work:
 - a. Show the complete sequence of abatement activities and the sequencing of Work within each building or building section.
 - b. Show the dates for the beginning and completion of each major element of Work including substantial completion dates for each Work Area, building, or phase.
 2. Work procedures that will be utilized (including anticipated decon and negative air exhaust locations).
 3. Estimated crew size.
 4. The anticipated work hours.
 5. Emergency procedures for fire and medical emergencies and for failure of containment barriers.
 6. Project Notifications: As required by Federal and State regulatory agencies together with proof of transmittal (i.e. certified mail return receipt).
 7. Building Occupant Notification: As required by regulatory agencies.
 8. Abatement Work Plan: Provide plans that clearly indicate the following:
 - a. All Work Areas/containments numbered sequentially.
 - b. Locations and types of all decontamination enclosures.
 - c. Entrances and exits to each Work Areas/containments.
 - d. Type of abatement activity/technique for each Work Area/containment.
 - e. Number and location of negative air units and exhaust. Also provide calculations for determining number of negative air pressure units.
 - f. Proposed location and construction of storage facilities and field office.
 - g. Location of water and electrical connections to building services.
 - h. Waste transport routes through the building to the waste storage container.
 9. Disposal Site/Landfill Permit from applicable regulatory agency.
 10. NYS Department of Environmental Conservation Waste Transporter Permit.
- E. **Progress Meetings:** The Owner's Representative will hold general progress meetings as required. A representative of the Contractor and the Owner is to be properly represented at each meeting.
- F. **Daily Log:** The Contractor is to maintain within the Decontamination Unit a daily log documenting the dates and time of, but not limited to, the following items:
1. Meetings; purpose, attendees, brief discussion
 2. Visitations; authorized and unauthorized
 3. Special or unusual events, i.e. barrier breeching, equipment failures, accidents
 4. Air monitoring tests and test results.
 5. Other entries as detailed in Code Rule 56-7.3 Asbestos Contractor Daily Project Log.

Submit three (3) copies of this log at final closeout of the Project as a Project closeout submittal.

G. Project Monitor: The Project Monitor shall be a representative of the Owner during the asbestos abatement portion of the project. The Project Monitor has the following responsibilities:

1. The Project Monitor shall oversee work practices and inspect for compliance with all applicable regulations and standards, and the Contract Documents.
2. The Project Monitor shall have at all times access to the work areas whenever it is in preparation or in progress. The Contractor shall provide the Project Monitor with keys to all locks located on the entrance(s) to the decontamination unit(s) and all other secured areas.
3. The Project Monitor, in conjunction with the Owner, will be the interpreter of the requirements of the Contract Documents and the judge of the performance thereunder.
4. The Project Monitor and/or the Owner will have the authority to reject work which is not in compliance with the requirements of the Contract Documents or Federal, State, or Local Regulations. The decision of the Owner will be final.

H. Air Sampling and Analysis

1. Area Air Sampling and Analysis

- a. The Owner will be responsible for hiring an independent third party firm to perform the required area air sampling and analysis in accordance with ICR 56.
- b. The Contractor is required to ensure cooperation of its personnel with the Air Sampling Technician (AST) for general air sampling, and testing of each work area after completion of asbestos work prior to removal of containment barriers.
- c. All air samples shall be analyzed using Phase Contrast Microscopy (PCM) in accordance with NIOSH method 7400.

2. Personal Air Sampling:

- a. As per the requirements of OSHA 1926.1101, the Contractor shall be required to perform personal air monitoring in order to determine that appropriate respiratory protection is being utilized.
- b. The analysis of personal air samples shall be conducted by an ELAP approved laboratory, subject to approval of the Owner or the Owner's Representative.
- c. Results of personnel air sample analyses shall be available, verbally, within twenty-four (24) hours of sampling and shall be posted at the work site within 48 hours. Results shall be submitted in accordance with the requirements of Section 1.5 F.

3. Final Clearance Air Sampling:

- a. For Code Rule 56 PCM Analysis: When required, the clearance air monitoring results shall be considered satisfactory when every sample demonstrates an airborne concentration of asbestos fibers of less than 0.01 fibers per cubic centimeter, or the background level, whichever is greater.
- b. The Contractor shall pay for all additional costs incurred by the Owner, including additional air monitoring, project monitoring, engineering fees, and sample analysis required if clearance air monitoring fails, or if completion of abatement work is not in accordance with approved progress schedule.

1.6 GENERAL PROCEDURES

- A. General Requirements - Comply with Code Rule 56's procedures for entry, exit, logging in, showering, personal protective equipment, tools, clothing, etc., throughout the asbestos abatement. Respiratory equipment shall be as required by OSHA and air monitoring results. (Except for authorized visitors as required by Rule 56). Non-certified workers will not be allowed in the work area.
- B. Equipment and Waste Container Decontamination and Removal – Code Rule 56's procedures for large projects (cleaning, recontainerization, holding areas, etc.) shall be followed

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. General Requirements: Code Rule 56's requirements for materials and equipment shall apply.
- B. Miscellaneous protective materials - Provide plywood sheathing, hardboard, etc., as required to provide protective cover over surfaces of existing construction and finishes to eliminate damage resulting from work of this section, including impact and water damage. Poly shall comply with Code Rule-56 including fire retardant requirements.
- C. Water and electricity shall be furnished by Owner without charge. Contractor shall provide an in-line backflow preventer at water source, and utilize non-leaking hoses.
- D. The Contractor shall supply the Project Monitor and Air Monitor with sufficient electricity to operate all high volume air monitoring pumps as may be required during the course of the project.
- E. Asbestos Encapsulation Products: Encapsulation products used may be any commercially available bridging type encapsulant, specifically designed for the purpose of encapsulation of asbestos-containing materials.

PART 3 - EXECUTION

3.1 REMOVAL REQUIREMENTS

- A. Perform work under this contract in accordance with the standards referenced in Part 1 of this Section. The provisions of any site-specific variances to Code Rule 56, or other asbestos standards, obtained for this project may not be implemented until approval is given by the Owner or Owner's Representative.
- B. Work that results in the disturbance of asbestos-containing materials shall be performed by a licensed asbestos abatement contractor who employs certified workers in accordance with all applicable standards referenced herein. If additional suspect ACM is discovered during the course of abatement, the Contractor shall notify the Owner or Owner's Representative immediately.
- C. The Contractor shall protect all items/existing construction intended to remain.

- D. Should the area beyond the asbestos work area(s) become contaminated with asbestos-containing dust or debris as a consequence of the work, immediately institute emergency procedures established for asbestos removal. All costs incurred in decontaminating such non-work areas shall be borne by the Contractor at no additional cost to the Owner.

3.2 WORK AREA PREPARATION

- A. General Requirements: Code Rule 56's requirements for general work area preparation shall apply, including vacating, signs, power, timing, HVAC isolation, isolation barriers, objects, exits, toilets, etc.

3.3 PERSONAL AND WASTE DECONTAMINATION ENCLOSURE SYSTEMS

- A. Comply with Code Rule 56's requirements for enclosure, showers, room types and configuration, etc.

3.4 DECONTAMINATION ENCLOSURE SYSTEMS/WORK AREA BARRIERS

- A. General Requirements: Comply with Code Rule 56 requirements for maintenance of work area barriers. (Setting, inspection, repairs, cleaning, etc.)

3.5 HANDLING AND REMOVAL PROCEDURES

- A. General Requirements: Comply with Code Rule 56 requirements regarding handling and removal procedures.
- B. Dry removal or disturbance: No dry removal or disturbance of asbestos materials shall be permitted.
- C. Wetting requirements: The asbestos material shall be wetted as necessary with amended water to keep asbestos fibers from becoming airborne. If any friable material is encountered, all of its surfaces shall be saturated.
- D. The use of open flame, torches, welding and other Hot Work is not permitted without review and approval by the Owner or Owner's Representative. A Hot Work Permit system shall be required for authorized use.
- E. Cleaning of surfaces: After completion of all stripping work, surfaces where asbestos material has been removed or handled shall be HEPA vacuumed.

3.6 CLEANING PROCEDURES

- A. General requirements: Code Rule 56's requirements for containerization, dust cleanup, tools and enclosure cleanup, etc., shall apply. Cleanup shall be by HEPA vacuum.

- B. Post abatement requirements: Code Rule 56's requirements shall apply (tool/equipment cleanup, general cleanup, waste removal, clearance air monitoring, etc.).

3.7 ASBESTOS WASTE TRANSPORTATION AND DISPOSAL

- A. Contractor shall minimally transport and dispose of all of the Category I non-friable asbestos waste materials according to correct applicable NYSDEC transportation requirements, Part 364, and solid waste requirements Part 360.
- B. If any removed material is "friable", Contractor shall handle it as such and transport and dispose of as "friable" asbestos waste per regulations referenced in Part 1 of this Section.
- C. All waste generated as a result of this work shall be removed from the site within 10 days of completion and clearance of abatement work.
- D. Log disposal site transportation names, etc., per Code Rule 56.
- E. All loading, transportation, and disposal shall also comply with NESHAPS 40 CFR 61 - 150 paragraphs C, D and E including all requirements for loading signs, shipment records, content certificate, record receipts, notifications, etc.

3.8 TEMPORARY PROTECTION OF FACILITIES

- A. Contractor shall provide temporary enclosure as required to protect the existing facilities from adverse weather conditions and maintain the interior environment in its normal condition. The contractor shall maintain the building secure from intrusion at all times and exits shall be operational during construction whenever the building is occupied. Temporary door and window enclosures shall be secure, weather resistant and lockable, if operable.

3.9 RESTORATION

- A. Remove temporary decontamination facilities and restore area designated for these facilities to its original condition or better.
- B. After final clearance, the Contractor shall replace all filters of the associated portions of the existing building HVAC system that were affected by the abatement operations, remove locks and restore power. All temporary power supplies shall be disconnected, power lockouts removed and building power restored. All temporary plumbing shall be removed.
- C. Finishes damaged by asbestos removal operation including, but not limited to, plaster/paint damage due to taping of polyethylene sheeting and floor tile lifted due to humid conditions, shall be restored prior to final payment.
 - 1. Finishes unable to be restored shall be replaced under this Contract.
 - 2. All foam and expandable foam products and materials used to seal Work Area openings shall be completely removed upon completion of abatement activities.

- D. All penetrations (including, but not limited to, pipes, ducts, etc.) through fire rated construction shall be fire stopped using materials and systems tested in accordance with ASTM E814 on projects where re-insulation is part of the required work.

3.10 PROJECT COMPLETION REQUIREMENTS

- A. Submission by the Contractor to the Owner Representative of the job logbook as described in Section 1.5 paragraph F.
- B. Inspection of the work sites by the Contractor's Project Manager's representative and the Owner's Representative for substantial completion of the Scope of Work.
- C. Submission by the Contractor to the Owner of the waste disposal manifest verifying that all waste generated at the project site has been disposed of at an EPA approved waste site.

END OF SECTION 020800

SECTION 020810 - PROTECTION OF WORKERS – LEAD-CONTAINING MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Work of this Section shall be performed in accordance with the requirements of the Contract Documents, including but not limited to Instructions to Bidders, Agreement and General Conditions and General Requirements.

1.2 SCOPE

- A. Contractors are alerted to the fact that some surfaces contain lead paint / glazing. Lead is a toxic metal capable of causing damage to the nervous system, kidneys, bones, heart and reproductive system.
- B. Any alteration and/or repair that results in the disturbance of the paint coatings shall meet the requirements of OSHA CFR 29 1926.62 Construction Lead Standard.
- C. An environmental report titled “Pre-Renovation Asbestos, Lead-Based Paint and PCB Inspection” dated April 23, 2020, prepared by Stohl Environmental can be found in Attachment A immediately following this Section. These reports incorporate and include all testing data obtained for the site, based on project scope and materials reported to be disturbed by the structures planned demolition. See the attached report for detailed descriptions of the types of lead-based paint identified and the locations.

The following materials were identified as lead-based paint / glazing items:

- White Interior/Exterior Window Components
- White Metal Radiators
- White and Varnish Coated Wood Wainscoting
- Yellow, Green, White Plaster Walls/Ceilings
- Brown Metal Columns
- Varnish Coating Columns
- Door Casings
- Yellow Block Walls
- Varnish Coated Wood Door and Door Components

Lead was detected at low concentrations on a variety of other surfaces. Contractors should reference the regulated building materials inspection report in attachment A.

1.3 SUBMITTALS

- A. Contractors of each trade shall submit their written Lead Program prior to the start of work. The plan must identify potential sources of lead exposure and propose specific procedures to protect workers from those exposures.

1.4 DEFINITIONS

- A. **Action Level** means employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (30 ug/m³) calculated as an 8-hour time weighted average (TWA).
- B. **Exposure Assessment** means a Contractor's requirement to determine if any Contractor's employees may be exposed to lead at or above the action level.
- C. **Lead** means metallic lead, all inorganic lead compounds and organic lead soaps. Excluded from this definition are all other organic lead compounds.
- D. **Permissible Exposure Limit (PEL)** means employee exposure, without the use of respirators, to an airborne concentration of lead of 50 ug/m³ averaged over an 8-hour period.

PART 2 - PRODUCTS

None Specified.

PART 3 - EXECUTION

3.1 PROTECTION OF WORKERS

- A. All Contractors shall be responsible to conduct an exposure assessment and shall initially determine if any Contractor's employee may be exposed to lead at or above the action level where their work causes the disturbance of paint or paint coatings, or provide a negative exposure assessment for work tasks to be completed under this scope of work.

3.2 EXPOSURE ASSESSMENT

- A. The Contractor shall collect personal samples representative of a full shift including at least one sample for each job classification in each work area either for each shift or for the shift with the highest exposure.
 - 1. **Below the Action Level** - should the initial personal air monitoring results be less than 30 ug/m³ the Contractor shall make a written record of such determination. Further exposure determination need not be repeated except as follows:
 - a. Whenever there has been a change of equipment, process, control, personnel or a new task has been initiated that may result in additional employees being exposed to lead at or above the action level or may result in employees already exposed at or above the action level being exposed above the PEL, the employer shall conduct additional monitoring.
 - 2. **At or Above the Action Level but At or Below the PEL** - the Contractor shall

perform monitoring until at least two consecutive measurements taken at least 7 days apart, are below the action level at which time the Contractor may discontinue monitoring for that employee except as otherwise provided in paragraph 3.02.A.1.a.

3. **Above the PEL** - the Contractor shall perform monitoring until at least two consecutive measurements taken at least 7 days apart, are at or below the PEL but at or above the action level at which time the Contractor shall repeat monitoring for that Contractor's employee as specified in 3.02.A.2.

- B. The Contractor may submit a negative exposure assessment in lieu of performing exposure monitoring.

3.3 METHODS OF COMPLIANCE

- A. To the extent feasible, Contractors must reduce worker lead exposure to the Permissible Exposure Limit (PEL) of 50 ug/m³ by a combination of engineering controls, work practice, and administrative controls.
- B. Respiratory protection and other protective equipment must be provided and used to the extent that the engineering and work practice controls cannot reduce exposure to the PEL as specified within 29 CFR 1926.62.

3.4 HOUSEKEEPING (required whenever lead is disturbed)

- A. All surfaces shall be maintained as free as practical of accumulations of lead.
- B. Clean up of floors and other surfaces where lead accumulates shall wherever possible be cleaned by vacuuming or other methods that minimize the likelihood of lead becoming airborne.
- C. Shoveling, dry or wet sweeping and brushing may be used only where vacuuming or other equally effective methods have been tried and found not to be effective.
- D. Where vacuuming methods are selected, the vacuums shall be equipped with HEPA filters and used and emptied in a manner which minimizes the reentry of lead into the workplace.
- E. Compressed air shall not be used to remove lead from any surface unless the compressed air is used in conjunction with a ventilation system designed to capture the airborne dust created by the compressed air.

3.5 HYGIENE FACILITIES AND PRACTICES (required above the PEL)

- A. The Contractor shall assure that in areas where Contractor's employees are exposed to lead above the PEL without regard to the use of respirators, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied.

- B. Change Areas (required above the PEL and during exposure assessment)
1. The Contractor shall provide clean change areas for employees whose airborne exposure to lead is above the PEL, and as interim protection for employees.
 2. The Contractor shall assure that change areas are equipped with separate storage facilities for protective work clothing and equipment and for street clothes which prevent cross-contamination.
 3. The Contractor shall assure that Contractor's employees do not leave the workplace wearing any protective clothing or equipment that is required to be worn during the work shift.
- C. Showers (required above the PEL)
1. The Contractor shall provide shower facilities, where feasible, for use by Contractor's employees whose airborne exposure to lead is above the PEL.
 2. The Contractor shall assure where shower facilities are available, that Contractor's employees shower at the end of the work shift and shall provide an adequate supply of cleansing agents and towels for use by affected Contractor's employees.
- D. Eating Facilities (required above the PEL)
1. The Contractor shall provide lunchroom facilities or eating areas for Contractor's employees whose airborne exposure to lead is above the PEL, without regard to the use of respirators.
 2. The Contractor shall assure that lunchroom facilities or eating areas are as free as practicable from lead contamination and are readily accessible to Contractor's employees.
 3. The Contractor shall assure that Contractor's employees whose airborne exposure to lead is above the PEL, without regard to the use of a respirator, wash their hands and face prior to eating, drinking, smoking or applying cosmetics.
 4. The Contractor shall assure that Contractor's employees do not enter lunchroom facilities or eating areas with protective work clothing or equipment unless surface lead dust has been removed by vacuuming, downdraft booth, or other cleaning method that limits dispersion of lead dust.
- E. Handwashing Facilities (required whenever lead is disturbed)
1. The Contractor shall provide adequate handwashing facilities for use by Contractor's employees exposed to lead.
 2. Where showers are not provided the Contractor shall assure that Contractor's employees wash their hands and face at the end of the work shift.

3.6 MEDICAL SURVEILLANCE (required whenever lead is disturbed)

- A. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by 29 CFR 1926.62 (j) Medical Surveillance.

3.7 TRAINING (required whenever lead is disturbed)

- A. For all Contractor's employees who are subject to exposure to lead at or above the action level on any day or who are subject to exposure to lead compounds which may cause skin or eye irritation, the Contractor shall provide a training program in accordance with 29 CFR 1926.62 (1)(2).

3.8 SIGNS (required above the PEL)

- A. The Contractor shall post the following warning signs in each work area where Contractor's employees exposure to lead is above the PEL.

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

- B. The Contractor shall assure that signs are illuminated and cleaned as necessary so that the legend is readily visible.

3.9 RECORDKEEPING (required whenever lead is disturbed)

The Contractor is responsible to establish and maintain an accurate record of all monitoring and other data used in conducting Contractor's employee exposure assessments and for each Contractor's employee subject to medical surveillance as required per 29 CFR 1926.62 (n).

3.10 OBSERVATION OF MONITORING (required whenever lead is disturbed)

- A. The Contractor shall provide affected Contractor's employees or their designated representatives an opportunity to observe any monitoring of employee exposure to lead.
- B. Whenever observation of the monitoring of employee exposure to lead requires entry into an area where the use of respirators, protective clothing or equipment is required, the Contractor shall provide the observer with and assure the use of such respirators, clothing and equipment.
- C. Without interfering with the monitoring, observers shall be entitled to:
 1. Receive an explanation of the measurement procedures;
 2. Observe all steps related to the monitoring of lead performed at the place of exposure; and
 3. Record the results obtained or receive copies of the results when returned by the laboratory.

END OF SECTION 020810

SECTION 024119 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
- 2. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Section 01 10 00 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
- 2. Section 01 73 00 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing conditions and legal dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 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. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property and for dust control. Indicate proposed locations and construction of barriers.
- B. Schedule of selective demolition activities with starting and ending dates for each activity.
 - 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. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Predemolition photographs or video.
- E. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.
- G. Arrange selective demolition schedule so as not to interfere with Owner's operations.

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 ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner if available. Owner does not guarantee that existing conditions are same as those indicated in second documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function of design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Owner's Representative.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
- F. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by the salvage operations.

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.
 - 1. Comply with requirements for existing services/systems interruptions specified in Section 01 10 00 "Summary."
- 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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.\
- C. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Section 01 50 00 "Temporary Facilities and Controls."
- D. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 8. Dispose of demolished items and materials promptly.
- 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.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. 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 cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Concrete Slabs-on-Grade/walks: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 02 4296 - HISTORIC REMOVAL AND DISMANTLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes historic treatment procedures in the form of special types of selective demolition work for designated historic spaces, areas, rooms, and surfaces.
- B. Related Requirements:
 - 1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

- A. Dismantle: To disassemble or detach a historic item from a surface, or a non-historic item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- B. Existing to Remain: Existing items that are not to be removed or dismantled, except to the degree indicated for performing required Work.
- C. Remove: To take down or detach a non-historic item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- D. Retain: To keep existing items that are not to be removed or dismantled.
- E. Salvage: To protect removed or dismantled items and deliver them to Owner.

1.3 PRECONSTRUCTION MEETINGS

- A. Preconstruction Conferences: Conduct conferences at Project sites.
 - 1. Review minutes of Preliminary Historic Treatment Conference that pertain to removal and dismantling procedures and protection of historic areas and surfaces.
 - 2. Review list of items indicated to be salvaged.
 - 3. Review methods and procedures related to removal and dismantling work.
 - 4. Review fire prevention.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For historic removal and dismantling specialist.

- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by Contractor's removal and dismantling operations.
- C. Inventory of Salvaged Items: After removal or dismantling work is complete, submit a list of items that have been salvaged.

1.5 QUALITY ASSURANCE

- A. Historic Removal and Dismantling Specialist Qualifications: A qualified historic treatment specialist. General selective demolition experience is insufficient experience for historic removal and dismantling work.
- B. Removal and Dismantling Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of removal and dismantling work, including protection of surrounding and substrate materials and Project site.
- C. Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning removal and dismantling work. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.6 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Hazardous Materials: Hazardous materials are present in construction affected by removal and dismantling work. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials, except under procedures specified elsewhere in the Contract Documents.
 - 3. If unanticipated asbestos is suspected, stop work in the area of potential hazard, shut off fans and other air handlers ventilating the area, and rope off area until the questionable material is identified. Reassign workers to continue work in unaffected areas. Resume work in the area of concern after safe working conditions are verified.
- D. Storage or sale of removed or dismantled items on-site is not permitted unless otherwise indicated.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Preparation for Removal and Dismantling: Examine construction to be removed or dismantled to determine best methods to safely and effectively perform removal and dismantling work.
 - 1. Verify that affected utilities are disconnected and capped.
 - 2. Inventory and record the condition of items to be removed and dismantled for reinstallation or salvage. Enter this information on the submittal of inventory of salvaged items.
- B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
- C. Perform surveys as the Work progresses to detect hazards resulting from historic removal and dismantling procedures.

3.2 HISTORIC REMOVAL AND DISMANTLING

- A. General: Have removal and dismantling work performed by a qualified historic removal and dismantling specialist.
- B. Perform work according to the historic treatment program.
- C. Water-Mist Sprinkling: Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment according to the historic treatment program to ensure that such water does not create a hazard or adversely affect other building areas or materials.
- D. Anchorages:
 - 1. Remove anchorages associated with removed items.
 - 2. Dismantle anchorages associated with dismantled items.
 - 3. In non-historic surfaces, patch holes created by anchorage removal or dismantling according to the requirements for new work.
 - 4. In historic surfaces, patch or repair holes created by anchorage removal or dismantling according to Section that is specific to the historic surface being patched.

END OF SECTION 02 4296

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.

3. Form ties.
4. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Field quality-control reports.
- C. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 1. Provide continuous, true, and smooth concrete surfaces.
 2. Furnish in largest practicable sizes to minimize number of joints.
 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

- a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
 - 2) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
 - 3) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 RELATED MATERIALS

- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.

3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 1. Minimize joints.
 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 1. Provide and secure units to support screed strips
 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Clean embedded items immediately prior to concrete placement.

3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

- a. Special inspection and testing and inspecting agency procedures for field quality control.
- b. Construction contraction and isolation joints.
- c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For testing and inspection agency.

- B. Welding certificates.
 - 1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 1. Finish: Galvanized.

2.3 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 2. Stagger splices in accordance with ACI 318.
- G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Place joints perpendicular to main reinforcement.
 2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 1. Steel-reinforcement placement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS

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

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Anchor rod and anchorage device installation tolerances.

- e. Cold and hot weather concreting procedures.
- f. Concrete finishes and finishing.
- g. Curing procedures.
- h. Forms and form-removal limitations.
- i. Shoring and reshoring procedures.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- l. Concrete repair procedures.
- m. Concrete protection.
- n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- o. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Slag cement.
- 4. Blended hydraulic cement.
- 5. Silica fume.
- 6. Performance-based hydraulic cement
- 7. Aggregates.
- 8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 9. Curing materials.
- 10. Joint fillers.
- 11. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.
- 5. Slump limit.
- 6. Air content.
- 7. Nominal maximum aggregate size.
- 8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
- 9. Intended placement method.
- 10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

- C. Shop Drawings:
 - 1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
 - 1. Concrete Class designation.
 - 2. Location within Project.
 - 3. Exposure Class designation.
 - 4. Formed Surface Finish designation and final finish.
 - 5. Final finish for floors.
 - 6. Curing process.
 - 7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 - 1. Installer: Include copies of applicable ACI certificates.
 - 2. Ready-mixed concrete manufacturer.
 - 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Curing compounds.
 - 4. Floor and slab treatments.
 - 5. Bonding agents.
 - 6. Adhesives.
 - 7. Semirigid joint filler.
 - 8. Joint-filler strips.
 - 9. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Slag cement.
 - 4. Blended hydraulic cement.
 - 5. Silica fume.
 - 6. Performance-based hydraulic cement.
 - 7. Aggregates.
 - 8. Admixtures:

- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
 - 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
 - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
- D. Field Quality-Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II.

2. Fly Ash: ASTM C618, Class C or F.
 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 CURING MATERIALS

- A. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.
- B. Curing Paper: 8-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- C. Water: Potable or complying with ASTM C1602/C1602M.

2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A], except with maximum water-vapor permeance of 0.01 Perms grains/(ft² · hr · inHg); not less than 20 mils (0.50 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Basis of Design Product: Subject to compliance with requirements, provide Stego Wrap 20-Mil Vapor Barrier by Stego Industries LLC., (877) 464-7834
www.stegoindustries.com or comparable product by one of the following:

- a. Americover
- b. Reef Industries

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 2. Slag Cement: 50 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

2.8 CONCRETE MIXTURES

- A. Normal-weight concrete used for footings.
 1. Exposure Class: ACI 318 F0.
 2. Minimum Compressive Strength: 4000 psi at 28 days.
 3. Maximum w/cm: 0.50.
 4. Slump Limit: 4 inches, plus or minus 1 inch.
 5. Air Content: 3.5 percent, plus or minus 1.5 percent at point of delivery.
- B. Normal-weight concrete used for interior slabs-on-ground.
 1. Exposure Class: ACI 318 F0.
 2. Minimum Compressive Strength: 5000 psi at 28 days.
 3. Maximum w/cm: 0.45.
 4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
 5. Slump Limit: 4 inches, plus or minus 1 inch (8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.)
 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
- C. Normal-weight concrete used for interior and exterior suspended slabs.
 1. Exposure Class: ACI 318 F0.
 2. Minimum Compressive Strength: 5000 psi at 28 days.
 3. Maximum w/cm: 0.45.
 4. Minimum Cementitious Materials Content: 540 lb/cu. Yd..

5. Slump Limit: 4 inches, plus or minus 1 inch (8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.)
6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors. Otherwise, provide 5.5 percent, plus or minus 1.5 percent at point of delivery for exterior slabs.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.

4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 3. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

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

3.7 FINISHING FLOORS AND SLABS

- #### A.
- Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
 - b. Suspended Slabs:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

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

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 6 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 5. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.9 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.

- c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
- 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Curing Compound:
 - 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.

- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.10 TOLERANCES

- A. Conform to ACI 117.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month(s).
 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 1. Repair and patch defective areas when approved by Architect.
 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.

- e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 3. After concrete has cured at least 14 days, correct high areas by grinding.
 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

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

3.13 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.

- 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.14 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

END OF SECTION 033000

SECTION 040310 - HISTORIC MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes historic treatment work consisting of cleaning historic clay brick, terra cotta and stone masonry surfaces.
- B. Related Requirements:
 - 1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
 - 2. US Department of the Interior Preservation Brief 1 "Assessing Cleaning and Water-Repellant Treatments for Historic Buildings"
 - 3. US Department of the Interior Preservation Brief 38 "Removing Graffiti from Historic Masonry"

1.2 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference on historic masonry cleaning at Project site.
 - 1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment, masonry cleaning, and fire protection.
 - 2. Review methods and procedures related to cleaning historic masonry.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.6 QUALITY ASSURANCE

- A. Historic Treatment Specialist Qualifications: A qualified historic masonry cleaning specialist. Experience cleaning new masonry work is insufficient experience for historic treatment work.

- B. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Cleaning: Clean an area approximately 25 sq. ft. for each type of masonry and surface condition.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

- A. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinseable, solvent-type paste or gel formulation, for removing paint from masonry.
 - 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. Hydroclean; Hydrochemical Techniques, Inc.
 - b. PROSOCO, Inc.
 - c. Shore Corporation.
- B. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinseable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry; and containing no methanol or methylene chloride.
 - 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. Dumond Chemicals, Inc.
 - b. PROSOCO, Inc.
- C. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinseable, solvent-type paste or gel formulation for removing paint from masonry; and containing no methanol or methylene chloride.
 - 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. Dumond Chemicals, Inc.
 - b. PROSOCO, Inc.

2.2 CLEANING MATERIALS

- A. Water: Potable.

- B. Hot Water: Water heated to a temperature of 140 to 160 deg F.
- C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.
- D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 5 quarts of 5 percent sodium hypochlorite (bleach), and 15 quarts of hot water for every 5 gal. of solution required.
- E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.
 - 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. Dumond Chemicals, Inc.
 - b. PROSOCO, Inc.
- F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Building Restoration Products, Inc.
 - b. Dumond Chemicals, Inc.
 - c. PROSOCO, Inc.
- G. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.
 - 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 Building Restoration Products, Inc.
 - b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
 - c. PROSOCO, Inc.
- H. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.
 - 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 Building Restoration Products, Inc.
 - b. Dumond Chemicals, Inc.
 - c. Hydroclean; Hydrochemical Techniques, Inc.
 - d. PROSOCO, Inc.
- I. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.
- a. American Building Restoration Products, Inc.
 - b. Dumond Chemicals, Inc.
 - c. Hydroclean; Hydrochemical Techniques, Inc.
 - d. PROSOCO, Inc.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.
1. Provide temporary rain drainage during work to direct water away from building.

3.2 CLEANING MASONRY, GENERAL

- A. Proceed with cleaning in an orderly manner; work from bottom to top of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- B. Use only those cleaning methods indicated for each masonry material and location.
1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
 2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.
 - a. Equip units with pressure gauges.
 - b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
 - c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
 - d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
- C. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without

streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

- D. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches from masonry surface, and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

3.3 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open masonry joints to whatever depth they occur.
- B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.
 - 1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
 - 2. Remove paint and calking with solvent-type paint remover.
 - 3. Comply with requirements in "Paint Removal" Article.
 - a. Repeat application up to two times if needed.
 - 4. Remove asphalt and tar with solvent-type paste paint remover.
 - a. Comply with requirements in "Paint Removal" Article.
 - b. Apply paint remover only to asphalt and tar by brush without prewetting.
 - c. Allow paint remover to remain on surface for 10 to 30 minutes.
 - d. Repeat application if needed.

3.4 PAINT REMOVAL

- A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- B. Paint Removal with Solvent-Type Paste Paint Remover:
 - 1. Remove loose and peeling paint using low -pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 - 2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
 - 3. Allow paint remover to remain on surface for period recommended in writing by manufacturer.

4. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.

C. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer.
5. Scrape off paint and remover.
6. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.

3.5 CLEANING BRICKWORK

A. Detergent Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold water applied by low pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

C. Nonacidic Gel Chemical Cleaning:

1. Wet surface with hot water applied by low-pressure spray.

2. Apply gel cleaner in 1/8-inch thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Remove bulk of gel cleaner.
5. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
6. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.6 CLEANING UNPOLISHED STONWORK

A. Detergent Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low- pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold water applied by low pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup

C. Nonacidic Gel Chemical Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply gel cleaner in 1/8-inch thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Remove bulk of gel cleaner.
5. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
6. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

D. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

E. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

F. One-Part Limestone Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Immediately repeat application of one-part limestone cleaner as indicated above over the same area.
5. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection and provide on-site assistance when requested by Architect. Have paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than twice to observe progress and quality of the Work.

END OF SECTION 04 0310

SECTION 04 0323 - HISTORIC BRICK UNIT MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes historic treatment work consisting of repointing brick masonry joints.
- B. Related Requirements:
 - 1. Section 013591 "Historic Treatment Procedures."
 - 2. Section 024296 "Historic Removal and Dismantling"
 - 3. US Department of the Interior Preservation Brief 2 "Repointing Mortar Joints in Historic Buildings"

1.2 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference historic masonry repair and repointing at Project.
 - 1. Review methods and procedures related to repointing historic brick masonry.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.6 QUALITY ASSURANCE

- A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or non-historic masonry is insufficient experience for masonry historic treatment work.

- B. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Repointing: Rake out joints in two separate areas each approximately 36 inches high by 48 inches wide for each type of repointing required and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150/C 150, Type I or Type II; white where required for color matching of exposed mortar.
 - 1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Sand: ASTM C 144 unless otherwise indicated.
 - 1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
 - 2. Color: Provide natural sand of color necessary to produce required mortar color.
 - 3. Provide sand with rounded edges.
- D. Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.
 - 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. Davis Colors.
 - b. Lanxess Corporation.
 - c. Solomon Colors, Inc.
- E. Water: Potable.

2.2 MORTAR MIXES

- A. General:
 - 1. Mortar mixes must match the historic mortar in color, texture and tooling.
 - 2. The sand component must match the sand in the historic mortar.
 - 3. The new mortar must have greater vapor permeability and be softer than the masonry units.
 - 4. The new mortar must be as vapor permeable and as soft or softer than the historic mortar.

- B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
 - 1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.
- C. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
 - 1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.
- D. Do not use admixtures in mortar unless otherwise indicated.
- E. Mixes: Mix mortar materials in the following proportions:
 - 1. Pointing Mortar by Type: ASTM C 270, Proportion Specification, Type O or Type K unless otherwise indicated as necessary to match the existing mortar mixes.
 - 2. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Prevent mortar from staining face of surrounding masonry and other surfaces.
- B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry repointing work. Reinstall when repointing is complete.
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.2 REPOINTING MASONRY

- A. Rake out and repoint joints to the following extent:
 - 1. All joints in areas indicated.
 - 2. Joints at locations of the following defects:
 - a. Holes and missing mortar.

- b. Cracks that can be penetrated 1/4 inch or more by a knife blade 0.027 inch thick.
 - c. Cracks 1/8 inch or more in width and of any depth.
 - d. Hollow-sounding joints when tapped by metal object.
 - e. Eroded surfaces 1/4 inch or more deep.
 - f. Deterioration to point that mortar can be easily removed by hand, without tools.
 - g. Joints filled with substances other than mortar.
- B. Do not rake out and repoint joints where not required.
- C. Rake out joints as follows, according to procedures demonstrated in approved mockup:
1. Remove mortar from joints to depth of 2 to 2-1/2 times joint width, but not less than 1 inch or not less than that required to expose sound, un-weathered mortar. Do not remove unsound mortar more than 2 inches deep; consult Architect for direction.
 2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
 3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.
 - a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
 - b. Angle grinders with diamond-impregnated metal blades may be used on horizontal joints only to cut out center of mortar bed joints. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet.
- D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
- E. Pointing with Mortar:
1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
 2. Where existing mortar has been removed to a depth of greater than 1 inch, these deeper areas should be filled first, compact the new mortar in several layers. The back of the entire joint should be filled successively by applying approximately 1/4 inch of mortar, packing it well into the back corners.
 3. Apply in layers not greater than 1/4 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
 4. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 1/4 inch. Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
 5. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.

6. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
 - a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
 - b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.
 7. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.
- F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.3 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.
1. Do not use metal scrapers or brushes.
 2. Do not use acidic or alkaline cleaners.

END OF SECTION 04 0323

SECTION 04 0343 - HISTORIC STONE MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes historic treatment work consisting of repointing stone masonry joints.
- B. Related Requirements:
 - 1. Section 013591 "Historic Treatment Procedures."
 - 2. US Department of the Interior Preservation Brief 2 "Repointing Mortar Joints in Historic Buildings"

1.2 DEFINITIONS

- A. Low-Pressure Spray: 150 to 200 psi; 4 to 6 gpm.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to repointing historic stone masonry.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

- A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or non-historic masonry is insufficient experience for masonry historic treatment work.
- B. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Repointing: Rake out joints in two separate areas each approximately 36 inches high by 48 inches wide for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type II; white where required for color matching of exposed mortar.
 - 1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Sand: ASTM C 144 unless otherwise indicated.
 - 1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
 - 2. Color: Provide natural sand of color necessary to produce required mortar color.
 - 3. Provide sand with rounded edges.
- D. Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.
 - 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. Davis Colors.
 - b. Lanxess Corporation.
 - c. Solomon Colors, Inc.
- E. Water: Potable.

2.2 MORTAR MIXES

- A. General:
 - 1. Mortar mixes must match the historic mortar in color, texture and tooling.
 - 2. The sand component must match the sand in the historic mortar.
 - 3. The new mortar must have greater vapor permeability and be softer than the masonry units.
 - 4. The new mortar must be as vapor permeable and as soft or softer than the historic mortar.
- B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
 - 1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp,

unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

- C. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
 - 1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.
- D. Do not use admixtures in mortar unless otherwise indicated.
- E. Mixes: Mix mortar materials in the following proportions:
 - 1. Pointing Mortar by Type: ASTM C 270, Proportion Specification, Type O or Type K unless otherwise indicated as necessary to match the existing mortar mixes.
 - 2. Rich Lime Mortar:
 - a. Replicate existing mortar color and texture. Provide samples for Architect's approval.
 - b. Mix proportions: 1 part hydrated lime and 2 parts sand.
 - c. Binder to aggregate ration: 1 : 3.
 - 3. Alternate Mortar Mix:
 - a. If produced better results, this mix helps with color matching if rich lime mortar mix becomes difficult. Provide samples for Architect's approval if alternate mix is used.
 - b. Replicate existing mortar color and texture.
 - c. Mix proportions: 1 part natural hydraulic lime 2.0 and 3 parts sand.
 - 4. Add mortar pigments to produce mortar colors that replicate existing.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Prevent mortar from staining face of surrounding stone and other surfaces.
- B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during stone repointing work. Reinstall when repointing is complete.
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.2 REPOINTING STONEMWORK

- A. Rake out and repoint joints to the following extent:
1. All joints in areas indicated.
 2. Joints at locations of the following defects:
 - a. Holes and missing mortar.
 - a. Cracks that can be penetrated 1/4 inch or more by a knife blade 0.027 inch thick.
 - b. Cracks 1/8 inch or more in width and of any depth.
 - c. Hollow-sounding joints when tapped by metal object.
 - d. Eroded surfaces 1/4 inch or more deep.
 - e. Deterioration to point that mortar can be easily removed by hand, without tools.
 - f. Joints filled with substances other than mortar.
- B. Do not rake out and repoint joints where not required.
- C. Rake out joints as follows, according to procedures demonstrated in approved mockup:
1. Remove mortar from joints to depth of 2 to 2-1/2 times joint width, but not less than 1 inch or not less than that required to expose sound, un-weathered mortar. Do not remove unsound mortar more than 2 inches deep; consult Architect for direction.
 2. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
 3. Do not spall edges of stone units or widen joints. Replace or patch damaged stone units as directed by Architect.
 - a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
 - b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet.
- D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose stone, rotted wood, rusted metal, and other deteriorated items.
- E. Pointing with Mortar:
1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
 2. Where existing mortar has been removed to a depth of greater than 1 inch, these deeper areas should be filled first, compact the new mortar in several layers. The back of the entire joint should be filled successively by applying approximately 1/4 inch of mortar, packing it well into the back corners.
 3. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 1/4 inch until a uniform depth is

formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

4. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 1/4 inch. Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing stone has worn or rounded edges, slightly recess finished mortar surface below face of stone to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed stone surfaces or to featheredge the mortar.
 5. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
 6. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
 - a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
 - b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.
 7. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.
- F. Where repointing work precedes cleaning of existing stone, allow mortar to harden at least 30 days before beginning cleaning work.

3.3 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
1. Do not use metal scrapers or brushes.
 2. Do not use acidic or alkaline cleaners.

END OF SECTION 04 0343

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Miscellaneous masonry accessories.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
- C. Samples for Verification: For each type and color of the following:
1. Exposed CMUs.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Material Certificates: For each type and size of the following:

1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Integral water repellant used in CMUs.
 3. Cementitious materials. Include name of manufacturer, brand name, and type.
 4. Mortar admixtures.
 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 6. Grout mixes. Include description of type and proportions of ingredients.
 7. Reinforcing bars.
 8. Joint reinforcement.
 9. Anchors, ties, and metal accessories.
- C. 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 in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- D. 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 in accordance with TMS 602/ACI 530.1/ASCE 6.
- E. 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 in accordance with ASTM C1093 for testing indicated.
- 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.
 - B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
 - C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

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.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls.
- C. 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.
- D. 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.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural 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) in accordance with TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. 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.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.5 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

- B. Concrete Lintels Matching CMU in Color, Texture: ASTM C1623, matching density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content is not more than 0.1 percent when tested in accordance with ASTM C114.

- B. Masonry Cement: ASTM C91/C91M.

- C. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

- D. Aggregate for Grout: ASTM C404.

- E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

- F. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- G. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A615 or ASTM A996, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to 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.
- C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.
 - 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.187-inch diameter.
 - 4. Wire Size for Cross Rods: 0.187-inch diameter.
 - 5. Spacing of Cross Rods: Not more than 16 inches o.c.
 - 6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
 - 2. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

- 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 mortar or grout.
 2. Use masonry cement mortar unless otherwise indicated.
 3. For exterior masonry, use masonry cement mortar.
 4. For reinforced masonry, use masonry cement mortar.
 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, As indicated.
 2. For reinforced masonry, As indicated.
 3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

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 the Work.
 2. Verify that foundations are within tolerances specified.

3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. 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.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 4. 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 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 6. 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.
 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For 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.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 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.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- 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 stepping 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.
- 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 nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above. Space anchors 48 inches o.c. unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs 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.

3.6 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 in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: 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 using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.

3.8 LINTELS

- A. Provide masonry lintels where shown and where openings of more than and 24 inches are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 REINFORCED UNIT MASONRY

- 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 loads that may be placed on them during construction.
- 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 enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner 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 is done at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level B in TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- 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, in accordance with ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- G. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.
- H. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 28 days.

3.11 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. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.12 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. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall panels.
2. Trim units.
3. Mortar materials.
4. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Verification:

1. For each color and texture of cast stone required, 4 inches (100 mm) square in size.
2. For each trim shape required, 4 inches (100 mm) in length.
3. For colored mortar, make Samples using same sand and mortar ingredients to be used on Project.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by CSI or PCI for Group A, Category AT.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone to avoid delaying the Work and to minimize the need for on-site storage.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.5 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Cast Stone: Obtain cast stone units from single source from single manufacturer.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 CAST STONE MATERIALS

- A. General: Comply with ASTM C1364, Wet cast method.
- B. Portland Cement: ASTM C150/C150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C114. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33/C33M; gradation and colors as needed to produce required cast stone textures and colors.

- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33/C33M, gradation and colors as needed to produce required cast stone textures and colors.
- E. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
- F. Admixtures: Use only admixtures specified or approved in writing by Architect.
 - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 - 3. Air-Entraining Admixture: ASTM C260/C260M. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
 - 4. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 5. Water-Reducing, Retarding Admixture: ASTM C494/C494M, Type D.
 - 6. Water-Reducing, Accelerating Admixture: ASTM C494/C494M, Type E.

2.3 CAST STONE UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. RockCast Architectural Masonry Veneer (Basis of Design).
 - 2. Echelon Masonry Products.
 - 3. Architectural Cast Stone.
- B. Cast Stone Units: Comply with ASTM C1364.
 - 1. Units are manufactured using the manufacturer's selected method.
 - 2. Wall Panels: Sizes as indicated on Drawings.
 - 3. Trim units including items as indicated on Drawings.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements unless otherwise indicated.
- D. Fabrication Tolerances:
 - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch (3 mm).
 - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater, but in no case by more than 1/4 inch (6 mm).
 - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater.

4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch (3 mm) on formed surfaces of units and 3/8 inch (10 mm) on unformed surfaces.

E. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
 - b. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.

F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

G. Colors and Textures: As selected by Architect from manufacturer's full range.

2.4 MORTAR MATERIALS

A. Provide mortar materials that comply with Section 042000 "Unit Masonry.

B. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Fine Aggregates: ASTM C33, except for gradation. Manufactured or natural sands.

E. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Davis Colors; Trye Tone Mortar Colors.
 - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - c. Solomon Colors, Inc.; sgs Mortar colorsz

- G. Water: Potable.

2.5 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- B. Proprietary Acidic 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 cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSoCo, Inc.
 - b. EaCo Chem, Inc.
 - c. Diedrich Technologies, Inc.

2.6 MORTAR MIXES

- A. 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 mortar or grout.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Comply with ASTM C270, Proportion Specification.
 - 1. For setting mortar, use Type N.
 - 2. For pointing mortar, use Type N.
- C. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 - 1. Mix to match Architect's sample.
 - 2. Application: Use colored-aggregate mortar for exposed mortar joints.

2.7 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C1364.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 SETTING CAST STONE IN MORTAR

- A. Set cast stone as indicated in TMS 604.
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.
 - 1. Set units with joints 3/8 inch (6 to 10 mm) wide unless otherwise indicated.
 - 2. Build anchors and ties into mortar joints as units are set.
 - 3. Fill dowel holes and anchor slots with mortar.
 - 4. Fill collar joints solid as units are set.
 - 5. Build concealed flashing into mortar joints as units are set.
 - 6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
- E. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- F. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.
- G. Point joints with sealant to comply with applicable requirements in Section 079200 "Joint Sealants."
 - 1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- H. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.

1. Keep joints free of mortar and other rigid materials.
2. Build in compressible foam-plastic joint fillers where indicated.
3. Form joint of width indicated, but not less than 3/8 inch (10 mm).
4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
 1. Remove mortar fins and smears before tooling joints.
 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 5. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 05 0371 - HISTORIC DECORATIVE METAL CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of decorative metal in the form of cleaning as follows:

1. Cleaning metal.
2. Removing corrosion.
3. Removing paint and priming for repainting.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative metal and fire protection.
2. Review methods and procedures related to historic treatment of decorative metal.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal cleaning specialist. Cleaning specialist shall be experienced in using mechanical and chemical methods on the types of metal surfaces indicated.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F.
- C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.
- D. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.
 - 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. Cathedral Stone Products, Inc.
 - b. PROSOCO, Inc.
- E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

- A. Alkaline-Paste Paint Remover: Manufacturer's standard alkaline-paste or gel formulation for removing paint from metals, and containing no methylene chloride.
 - 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 Building Restoration Products, Inc.
 - b. PROSOCO, Inc.
- B. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinseable solvent-type paste, gel, or foamed emulsion formulation for removing paint from metals; and containing no methanol or methylene chloride.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Building Restoration Products, Inc.
 - b. PROSOCO, Inc.

2.3 FERROUS METAL PRIMERS

- A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free, universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry-film thickness.

PART 3 - EXECUTION

3.1 HISTORIC DECORATIVE METAL CLEANING, GENERAL

- A. Execution of the Work: In cleaning historic items, disturb them as minimally as possible and as follows:
 - 1. Remove deteriorated coatings and corrosion.
 - 2. Sequence work to minimize time before protective coatings are reapplied.
 - 3. Clean items in place unless otherwise indicated.
- B. Mechanical Coating Removal: Use only the gentlest mechanical methods, such as scraping and wire brushing, that will not abrade metal substrate. Do not use abrasive methods such as sanding or power tools except as indicated as part of the historic treatment program and approved by Architect.
- C. Repaint: Where indicated, prepare painted decorative metal by [cleaning surface, removing less than firmly adhered existing paint, sanding edges smooth,] [removing existing paint] and priming for painting as specified.

3.2 CLEANING

- A. General: Use only those methods indicated for each type of decorative metal and its location.
 - 1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
 - 2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.
 - a. Equip units with pressure gages.
 - b. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
 - c. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
 - 3. Uniformity: Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.

- B. Water Cleaning: Clean with hot water applied by low pressure spray. Supplement with natural-fiber or plastic bristle brush. Use small brushes to remove soil from joints and crevices.
- C. Detergent Cleaning:
 - 1. Wet surface with hot water applied by low-pressure spray.
 - 2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
 - 3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
- D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.
 - 1. Wet surface with cold water applied by low-pressure spray.
 - 2. Apply cleaner to surface in two applications by brush.
 - 3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
 - 4. Non-Ferrous Metals: Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
 - 5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.
- E. Cleaning with Abrasive Pads: Clean surfaces to remove dirt, leaving uniform patina intact, by light rubbing with abrasive pads and water. Rinse with cold water to remove residue.
- F. Chemical Rust Removal:
 - 1. Remove loose rust scale with approved abrasives for ferrous metal cleaning.
 - 2. Apply rust remover with brushes or as recommended in writing by manufacturer.
 - 3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
 - 4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
 - 5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
 - 6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.
- G. Mechanical Rust Removal:
 - 1. Remove rust with approved abrasives for ferrous metal cleaning.
 - 2. Wipe off residue with mineral spirits and either steel wool or soft rags.
 - 3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
 - 4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.3 PAINT REMOVAL

A. General: Use only those paint-removal methods indicated for each type of decorative metal.

1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
2. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.

B. Paint Removal with Alkaline-Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted metal with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
5. Repeat process if necessary to remove all paint.

C. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted decorative metal with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
5. Repeat process if necessary to remove all paint.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage chemical-cleaner and paint-remover manufacturers' factory-authorized service representatives for consultation and Project-site inspection and to provide on-site assistance when requested by Architect.

3.5 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

END OF SECTION 05 0371

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Composite floor deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

- E. Qualification Statements: For welding personnel and testing agency.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ROOF DECK

- A. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 50 minimum, G60 zinc coating.
 - 2. Deck Profile: As indicated.
 - 3. Profile Depth: As indicated.
 - 4. Design Uncoated-Steel Thickness: As indicated.
 - 5. Span Condition: Triple span or more.
 - 6. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

- A. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 50, G60 zinc coating, minimum.
2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: As indicated.

2.4 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI standards for overhang and slab depth.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- G. Galvanizing Repair Paint: ASTM A780.
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Butted.

3.4 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.

2. Weld Spacing:
 - a. Space and locate welds as indicated.

- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 3-inches, with end joints as follows:
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 2. Steel decking will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Shelf angles.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Fasteners.
2. Shop primers.
3. Shrinkage-resisting grout.
4. Slotted channel framing.

- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
 2. Elevator machine beams, hoist beams, and divider beams.
 3. Steel shapes for supporting elevator door sills.
 4. Steel girders for supporting wood frame construction.
 5. Steel columns for supporting wood frame construction.
 6. Shelf angles.
 7. Loose steel lintels.
- C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates and Bars: ASTM A36.
- C. Steel Wide Flange Shapes: ASTM A992.
- D. Steel HSS Shapes: ASTM A500, Grade C.
- E. Steel Tubing: ASTM A500, Grade C.
- F. Steel Pipe: ASTM A53, Standard Weight (Schedule 40) unless otherwise indicated.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- D. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- E. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.3 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
 - 1. Provide bearing plates welded to beams and columns where indicated.
 - 2. Drill or punch girders and plates for field-bolted connections where indicated.
 - 3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- D. Fabricate steel columns for supporting wood frame construction from steel with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
- E. Galvanize miscellaneous framing and supports where indicated.

2.6 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.

B. Galvanize shelf angles located in exterior walls.

C. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.7 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.8 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.9 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
 3. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor shelf angles securely to existing construction as indicated.
- C. Support steel girders on solid grouted masonry, concrete, or steel columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of columns.
- D. Install columns on concrete footings with grouted baseplates..

3.3 REPAIRS

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Component Aluminum decorative railings.
2. Infill system for component aluminum decorative railings.

1.2 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. 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 items to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of decorative metal railings assembled from standard components.
2. Woven-wire mesh infill panels.
3. Fasteners.
4. Bituminous paint.
5. Metal finishes.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

1. For illuminated railings, include wiring diagrams and roughing-in details.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters

2. Fittings, end caps, and brackets.
3. Welded connections.

1.5 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 1. Build mockups for each form and finish of railing, consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.

- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
- 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- 2.2 METALS, GENERAL
- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
 - B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
- 2.3 ALUMINUM DECORATIVE RAILINGS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design Railing Product: Hollaender Manufacturing.
 - 2. Kee Lite
 - 3. C.R. Laurence
 - B. Source Limitations: Obtain aluminum decorative railing components from single source from single manufacturer.
 - C. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
 - D. Extruded Bars and Shapes, Including Extruded Tube: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52, 6005-T5.
 - E. Extruded Structural Pipe and Round Tube: ASTM B429/B429M, Alloy 6061-T6.
 - 1. Provide 1-1/2 in IPS, (1.90 in O.D.) Standard Weight (Schedule 40) pipe for rails, Schedule 80 for posts, unless otherwise indicated.
 - F. Drawn Seamless Tube: ASTM B210/B210M, Alloy 6063-T832.

- G. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.
- H. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.
- I. Base Flange and Fitting Castings: ASTM B26/B26M, Alloy Almag 535.
- J. Panels Clips: Alloy 6063-T6.
- K. Woven-Wire Mesh Infill Panels: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.162-inch (4.1-mm) nominal diameter aluminum wire complying with ASTM B211/B211M, Alloy 6061-T94.
 - 1. Basis-of-Design Product: Provided by railing manufacturer.

2.4 FASTENERS

- A. Fastener Materials:
 - 1. Aluminum Railing Components: Alloy steel fasteners with JS-600 zinc plating.
 - 2. Finish exposed fasteners to match appearance, including color and texture, of railings.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide Hollaender Speed-Rail® structural slip-on fittings for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated. Systems using adhesive or pop rivet attachment systems will not be accepted.
 - 2. Provide internal/external, reverse knurl, cup point, hex head set screws. Material to be alloy steel with JS 600 zinc plating.
- D. Fasten infill panels to rails and posts with railing manufacturer's panel clips. Secure the infill panels in the panel clips with reverse-knurl cup-point set screws. Fasten panel clips to rails and posts with 1/4 - 20 sheet metal screws.
- E. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC308.

2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast-aluminum, center of handrail 3-1/8 inches (79.4 mm) from face of railing.
 - 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.

- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with non-welded connections unless otherwise indicated. Welding will not be acceptable.
- H. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.
 - 1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- I. Form changes in direction as follows:
 - 1. By flush bends or by inserting prefabricated flush-elbow fittings.
- J. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.
 - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 - 2. Coordinate anchorage devices with supporting structure.
- N. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames.
 - 1. Fabricate wire mesh and frames from aluminum.
 - 2. Orient wire mesh with wires perpendicular and parallel to top rail.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. 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.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Anodic Finish: AA-M10C22A41, Architectural Class, 0.7 mil thickness or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.

2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3 m).

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

A. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post anchoring material flush with adjacent surface.

3.4 CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.5 PROTECTION

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

END OF SECTION 057300

SECTION 060312 - HISTORIC WOOD REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment of wood in the form of repairing wood features as follows:

1. Repairing wood paneling, railings, and trim.
2. Replacing wood paneling, railings, and trim.
3. Repairing, refinishing, and replacing hardware.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 080314 "Historic Treatment of Wood Doors" for historic wood door repairs, including related trim.
3. Section 080352 "Historic Treatment of Wood Windows" for historic wood window repairs, including related trim.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic wood repair.
2. Review methods and procedures related to historic wood repair.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, joinery, reinforcing, method of splicing or attaching wood members to other surfaces, accessory items, and finishes.

C. Samples: For each type of exposed wood and finish.

1.4 QUALITY ASSURANCE

- A. Historic Treatment Specialist Qualifications: A qualified historic wood-repair specialist, experienced in repairing, refinishing, and replacing wood in whole and in part. Experience only in fabricating and installing new woodwork is insufficient experience for wood historic treatment work.
- B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation, Project-site inspection, and on-site assistance.

1.5 MOCKUPS

- A. Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation. Prepare mockups so they are inconspicuous.
 - 1. Wood Baseboard Repair: Prepare an approximately **72-inch (2000-mm)** length of baseboard to serve as mockup to demonstrate samples of each type of wood repair.

PART 2 - PRODUCTS

2.1 HISTORIC WOOD REPAIR, GENERAL

- A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWMAC/WI's "North American Architectural Woodwork Standards" for construction, finishes, grade rules, and other requirements unless otherwise indicated.
 - 1. Exception: Industry practices cited in Section 12, Paragraph 6, "Industry Practices," under Article 12.1, "Basic Considerations," of AWMAC/WI's "North American Architectural Woodwork Standards" do not apply to the Work of this Section.

2.2 REPLICATED WOOD ITEMS

- A. Replicated Wood Paneling, Railings and Trim: Custom-fabricated replacement wood units and components.
 - 1. Wood Species: Match species of existing wood.
 - 2. Wood Member and Trim Profiles: Match profiles and detail of existing.
 - 3. Hardware: Reuse existing unless otherwise indicated. Refurbish to be in good working order. If it is not possible to reuse existing, match existing hardware.

2.3 WOOD-REPLACEMENT MATERIALS

- A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than **1/32 inch (0.8 mm)** deep by **2 inches (51 mm)** wide.
 - 1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.
- B. Paneling and Railings. Match existing species.
- C. Exterior Trim: Match existing species.
- D. Interior Trim: Match existing species.

2.4 WOOD-REPAIR MATERIALS

- A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.
- B. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound must be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound must be capable of filling deep holes and spreading to featheredge.

2.5 HARDWARE

- A. Hardware, General: Provide hardware required for each type of replicated or repaired wood, including, but not limited to, hinges, pulls, latches, fasteners, and accessories indicated or required for proper operation. Hardware must smoothly operate, tightly close, and secure units appropriately for frequency of use, unit weight, and dimensions.
- B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.
- C. Material and Design:
 - 1. Material: Solid bronze or alloy indicated unless otherwise indicated.
 - 2. Design: Match type and appearance of existing hardware.
- D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.6 MISCELLANEOUS MATERIALS

- A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage caused by fungi and wood-boring insects; complying with AWWA P5; containing no boric acid.
- B. Cleaning Materials:
 - 1. Detergent Solution: Solution prepared by mixing **2 cups (0.5 L)** of tetrasodium pyrophosphate (TSPP), **1/2 cup (125 mL)** of laundry detergent that contains no ammonia, **5 quarts (5 L)** of 5 percent sodium hypochlorite bleach, and **15 quarts (15 L)** of warm water for each **5 gal. (20 L)** of solution required.
 - 2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing **1/3 cup (80 mL)** of household detergent that contains no ammonia, **1 quart (1 L)** of 5 percent sodium hypochlorite bleach, and **3 quarts (3 L)** of warm water.
- C. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at **70 deg F (21 deg C)**, in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure condition.
- D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.
 - 1. Match existing fasteners in material and type of fastener unless otherwise indicated.
 - 2. Use concealed fasteners for interconnecting wood components.
 - 3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
 - 4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
 - 5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
 - 6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

2.7 WOOD FINISHES

- A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.
- B. Factory-Primed Replacement Units: Manufacturer's standard factory-prime coat on exposed exterior and interior wood surfaces; compatible with indicated finish coating.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean wood of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
- B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC WOOD REPAIR, GENERAL

- A. General: In treating historic items, disturb them as minimally as possible and as follows:
 - 1. Stabilize and repair wood to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
 - 2. Remove coatings and apply borate preservative treatment before repair. Remove coatings in accordance with Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
 - 3. Repair items in place where possible.
 - 4. Install temporary protective measures to protect wood-treatment work that is indicated to be completed later.
 - 5. Refinish historic wood in accordance with Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
- B. Mechanical Abrasion: Where mechanical abrasion is needed for the Work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods, such as sanding, wire brushing, or power tools, except as approved by Architect.
- C. Repair and Refinish Existing Hardware: Dismantle hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.
- D. Repair Wood: Match existing materials and features, retaining as much original material as possible to perform repairs.
 - 1. Unless otherwise indicated, repair wood by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
 - 2. Where indicated, repair wood by limited replacement matching existing material.
- E. Replace Wood: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

- F. Identify removed items with numbering system corresponding to item locations, to ensure reinstallation in same location.

3.3 WOOD PATCH-TYPE REPAIR

- A. General: Patch wood that exhibits depressions, holes, or similar voids, and that has limited amounts of rotted or decayed wood.
 - 1. Treat wood with wood consolidant prior to application of patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and refuses to absorb more. Allow treatment to harden before filling void with patching compound.
 - 2. Remove rotted or decayed wood down to sound wood.
- B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.
- C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.
 - 1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
 - 2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
 - 3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD-REPLACEMENT REPAIR

- A. General: Replace parts of or entire wood items at locations indicated on Drawings and where damage is too extensive to patch.
 - 1. Remove broken, rotted, and decayed wood down to sound wood.
 - 2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
 - 3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.
- B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
- C. Repair remaining depressions, holes, or similar voids with patch-type repairs.
- D. Reinstall items removed for repair into original locations.

END OF SECTION 060312

SECTION 061000 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking and nailers.
3. Wood furring.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of process and factory-fabricated product.
2. For preservative-treated wood products.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency

certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent for **2-inch nominal (38-mm actual)** thickness or less; unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than **18 inches (460 mm)** above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATMENT

- A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
 - 1. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat indicated on Drawings, and the following:
 - 1. Framing for raised platforms.
 - 2. Framing for stages.
 - 3. Concealed blocking.
 - 4. Framing for non-load-bearing partitions.
 - 5. Framing for non-load-bearing exterior walls.
 - 6. Roof construction.
 - 7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions by Grade: Construction or No. 2
 - 1. Application: All interior partitions.
 - 2. Species:
 - a. Southern pine or mixed southern pine; SPIB.
 - b. Northern species; NLGA.
 - c. Eastern softwoods; NeLMA.
 - d. Western woods; WCLIB or WWPA.
- B. Framing Other Than Non-Load-Bearing Partitions by Grade: No. 2 grade.

1. Application: Framing other than interior partitions
2. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine; SPIB.
 - c. Douglas fir-larch; WCLIB or WWPA.
 - d. Spruce-pine-fir; NLGA.
 - e. Douglas fir-south; WWPA.
 - f. Hem-fir; WCLIB or WWPA.
 - g. Douglas fir-larch (north); NLGA.
 - h. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Exposed Framing: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade: As indicated above for load-bearing construction of same type.

2.5 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Concealed Boards: 19 percent maximum moisture content and the following species and grades:

1. Mixed southern pine or southern pine; No. [2] [3] grade; SPIB.
2. Eastern softwoods; No. [2] [3] Common grade; NeLMA.
3. Northern species; No. [2] [3] Common grade; NLGA.
4. Western woods; [Construction or No. 2 Common] [Standard or No. 3 Common] grade; WCLIB or WWPA.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than **1-1/2 inches (38 mm)** into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fastener of Type 304 stainless steel.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

2.7 METAL FRAMING ANCHORS

- A. Allowable design loads, as published by manufacturer, are to meet or exceed those of products of manufacturers listed. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, **G60 (Z180)** coating designation.
 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); **G185 (Z550)** coating designation; and not less than **0.036 inch (0.9 mm)** thick.
 1. Use for wood-preservative-treated lumber and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets:
 1. Self-adhering sheet consisting of **64mils (1.6 mm)** of rubberized asphalt laminated on one side to a **4-mil- (0.10-mm-)** thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, [butyl rubber] [or] [rubberized-asphalt] compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than **0.025 inch (0.6 mm)**.
- C. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate [furring,]nailers, blocking, [grounds,]and similar supports to comply with requirements for attaching other construction.
- D. Install shear wall panels to comply with manufacturer's written instructions.
- E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

3.2 PROTECTION

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

Retain paragraph below if borate treatment of wood that has become wet is used to help prevent mold and mildew.

- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

1.1 SUMMARY

- A. Section Includes:
1. Roof sheathing.
 2. Subflooring and Underlayment

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated plywood.
 2. Fire-retardant-treated plywood.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
 - 1. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 - 3. Design Value Adjustment Factors: Treated lumber plywood is to be tested in accordance with ASTM D5516 and design value adjustment factors are to be calculated in accordance with ASTM D6305. Span ratings after treatment are to be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to **170 deg F (76 deg C)** are to be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

2.4 ROOF SHEATHING

- A. Plywood Sheathing, Roofs: DOC PS 1, Exterior, Structural I sheathing.

2.5 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor-Underlayment: DOC PS 1, single-floor panels.
- B. Oriented-Strand-Board Combination Subfloor-Underlayment: DOC PS 2, Exposure 1 single-floor panels.
- C. Plywood Subflooring: Either DOC PS 1 or DOC PS 2, Exterior, Structural I single-floor panels or sheathing.

- D. Oriented-Strand-Board Subflooring: DOC PS 2, Exposure 1 Structural I sheathing.
- E. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than **1/4 inch (6.4 mm)** over smooth subfloors and not less than **3/8 inch (9.5 mm)** over board or uneven subfloors.
 - 1. Plywood Underlayment for Resilient Flooring: DOC PS 1, with fully sanded face.
 - 2. Plywood Underlayment for Carpet: DOC PS 1.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof sheathing, provide fasteners of Type 304 stainless steel.

2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

LaBella Associates, D.P.C.
Project No. 2221723

Academic Innovation Hub
Work Force Development Training
Niagara University

April 2024

END OF SECTION 061600

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door frames.
2. Interior board paneling.

1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.
- C. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber, mark grade stamp on end or back of each piece[, **or omit grade stamp and provide certificates of grade compliance issued by grading agency**].
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.
- D. MDF: ANSI A208.2, [**Grade 130**] <Insert grade>.

- E. Particleboard: ANSI A208.1, [**Grade M-2**] [**Grade M-2-Exterior Glue**].

2.2 INTERIOR TRIM

- A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade:

Verify local availability before retaining species and grade in first seven subparagraphs below. Some grades in subparagraphs are considered "knotty." Other species and grades are available.

- a. Eastern white pine; NeLMA or NLGA [**C Select**] [**D Select**] [**Finish or 1 Common**] [**Premium or 2 Common**].
- b. Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA [**C Select (Choice)**] [**D Select (Quality)**] [**1 Common (Colonial)**] [**2 Common (Sterling)**].

Grading rules for eastern white pine are not the same as those for western pine, so requirements in first subparagraph below will vary somewhat among species.

- c. Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA [**C Select (Choice)**] [**D Select (Quality)**] [**Finish or 1 Common (Colonial)**] [**Premium or 2 Common (Sterling)**].
- d. White woods; WWPA [**C Select**] [**D Select**] [**1 Common**] [**2 Common**].
- e. Douglas fir-larch or Douglas fir south; NLGA, WCLIB, or WWPA [**Superior or C & Btr**] [**Prime or D**] finish.
- f. Southern pine; SPIB [**B & B**] [**C & Btr**] finish.
- g. Western red cedar; NLGA, WCLIB, or WWPA [**Clear Heart**] [**Grade A**] [**Grade B**].

Maximum moisture content for seasoned or kiln-dried, board-size lumber varies, depending on species, grade, and grading agency. See the Evaluations.

2. Maximum Moisture Content: [**19**] [**15**] percent[**with at least 85 percent of shipment at 12 percent or less**].
3. Finger Jointing: [**Allowed**] [**Not allowed**].
4. Face Surface: [**Surfaced (smooth)**] [**Saw textured**].

- B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

Fourth option in "Species and Grade" Subparagraph below includes light-colored, closed-grain species that will take stain; if retaining, delete undesirable species, if any, from list.

1. Species and Grade: [**Red oak**] [**White maple**] [**Alder**] [**Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar**] <Insert species>; NHLA [**Clear**] [**A Finish**] [**B Finish**].

NHLA does not define any maximum moisture content values for kiln-dried hardwood lumber; purchaser must specify the value. Percentages in "Maximum Moisture Content" Subparagraph below are based on ranges given for optimum moisture content in AWI's "Architectural Woodwork Standards." First option

applies to damp coastal areas of the southern United States and the Maritime Provinces. Second option applies to Ontario, Quebec, and most of the United States. Third option applies to the dry southwestern United States and to Alberta, Manitoba, and Saskatchewan.

2. Maximum Moisture Content: [13] [10] [9] <Insert number> percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: [Allowed] [Not allowed] [Use for lumber trim wider than **6 inches (150 mm)**].
5. Veneered Material: [Allowed] [Not allowed] [Use for lumber trim wider than **6 inches (150 mm)**].
6. Face Surface: [**Surfaced (smooth)**] [**Saw textured**].
7. Matching: Selected for compatible grain and color.

C. Softwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings. Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Species: [**Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine**] [**Southern pine**] [**Western red cedar**] [**Douglas fir**] <Insert species>.

Requirement in "Maximum Moisture Content" Subparagraph below is typical requirement of grading agencies for kiln-dried softwood moldings and molding stock.

2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.

Six subparagraphs below are examples of molding patterns that might be specified. Delete all if moldings are sufficiently detailed on Drawings. See MMPA's "WM/Series Softwood Moulding Patterns" for additional patterns.

5. Base Pattern: [WM 623, **9/16-by-3-1/4-inch (14-by-83-mm) ogee**] [WM 713, **9/16-by-3-1/4-inch (14-by-83-mm) ranch**] [WM 753, **9/16-by-3-1/4-inch (14-by-83-mm) beaded-edge**] [WM 620, **9/16-by-4-1/4-inch (14-by-108-mm) ogee**] [WM 750, **9/16-by-4-1/4-inch (14-by-108-mm) beaded-edge**] base.
6. Shoe-Mold Pattern: [WM 129, **7/16-by-11/16-inch (11-by-17-mm) quarter-round**] [WM 126, **1/2-by-3/4-inch (13-by-19-mm) quarter-round**] [WM 131, **1/2-by-3/4-inch (13-by-19-mm) ogee**] shoe mold.
7. Casing Pattern: [WM 327, **11/16-by-2-1/4-inch (17-by-57-mm) clamshell**] [WM 366, **11/16-by-2-1/4-inch (17-by-57-mm) featheredge**] [WM 376, **11/16-by-2-1/4-inch (17-by-57-mm) beaded-edge**] casing.
8. Mull-Casing Pattern: [WM 957, **3/8-by-1-3/4-inch (9.5-by-44-mm) beaded-edge**] [WM 973, **3/8-by-1-3/4-inch (9.5-by-44-mm) bullnose**] [WM 983, **3/8-by-1-3/4-inch (9.5-by-44-mm) featheredge**] casing.
9. Stop Pattern: [WM 856, **3/8-by-1-3/8-inch (9.5-by-35-mm) ranch**] [WM 946, **3/8-by-1-3/8-inch (9.5-by-35-mm) ogee**] [WM 886, **3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose**] stop.
10. Chair-Rail Pattern: WM 297, **11/16-by-3-inch (17-by-76-mm) chair rail**.

D. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings made to patterns included in MMPA's "HWM/Series Hardwood Moulding Patterns."

Third option in "Species" Subparagraph below includes light-colored, closed-grain hardwood species that will take stain; if retaining, delete undesirable species, if any, from list.

1. Species: [**Red oak**] [**White maple**] [**Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar**] <Insert species>.
2. Maximum Moisture Content: 9 percent.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Optional Material: Kiln-dried softwood or MDF, with exposed surfaces veneered with species indicated, may be used in lieu of solid wood.

Six subparagraphs below are examples of molding patterns that might be specified. Delete all if moldings are sufficiently detailed on Drawings. See MMPA's "HWM/Series Hardwood Moulding Patterns" for additional patterns.

6. Base Pattern: [**HWM 633, 7/16-by-3-1/4-inch (11-by-83-mm) ogee**] [**HWM 713, 7/16-by-3-1/4-inch (11-by-83-mm) ranch**] [**HWM 753, 7/16-by-3-1/4-inch (11-by-83-mm) beaded-edge**] [**WM 620, 7/16-by-4-1/4-inch (11-by-108-mm) ogee**] base.
7. Shoe-Mold Pattern: [**HWM 129, 7/16-by-11/16-inch (11-by-17-mm) quarter-round**] [**HWM 126, 1/2-by-3/4-inch (13-by-19-mm) quarter-round**] [**HWM 131, 1/2-by-3/4-inch (13-by-19-mm) ogee**] shoe mold.
8. Casing Pattern: [**HWM 328, 1/2-by-2-1/4-inch (13-by-57-mm) clamshell**] [**HWM 366, 1/2-by-2-1/4-inch (13-by-57-mm) featheredge**] [**HWM 376, 1/2-by-2-1/4-inch (13-by-57-mm) beaded-edge**] casing.
9. Mull-Casing Pattern: [**HWM 989, 3/16-by-2-inch (5-by-51-mm) square-edge**] [**HWM 988, 3/8-by-1-1/2-inch (9.5-by-38-mm) featheredge**] [**HWM 987, 3/8-by-2-inch (9.5-by-51-mm) featheredge**] casing.
10. Stop Pattern: [**HWM 856, 3/8-by-1-3/8-inch (9.5-by-35-mm) ranch**] [**HWM 946, 3/8-by-1-3/8-inch (9.5-by-35-mm) ogee**] [**HWM 886, 3/8-by-1-3/8-inch (9.5-by-35-mm) bullnose**] stop.
11. Chair-Rail Pattern: HWM 297, 11/16-by-3-inch (17-by-76-mm) chair rail.

2.3 PANELING

- A. Hardboard Paneling: Interior factory-finished hardboard paneling complying with ANSI A135.5.
 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
 2. Thickness: [**1/8 inch (3.2 mm)**] [**5/32 inch (4 mm)**] [**1/4 inch (6.4 mm)**].

Class I finishes have greater resistance to abrasion, fading, heat, humidity, scrape adhesion, and steam than Class II.

3. Finish: [**Class I**] [**Class II**].

"Surface-Burning Characteristics" Subparagraph below is an example only. Retain or revise to suit finish class and products.

4. Surface-Burning Characteristics: As follows, tested according to ASTM E84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

Retain one of three options in "Colors, Textures, and Patterns" Subparagraph below; if retaining first, indicate colors, textures, and patterns in additional subparagraphs.

5. Colors, Textures, and Patterns: [**As indicated by manufacturer's designations**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**].

"Board Paneling, MMPA" Paragraph below is a generic specification for wood-board paneling. Delete and retain "Board Paneling" Paragraph below if other grades and patterns, such as SPIB's or WWPA's, are used.

- B. Board Paneling, MMPA: Interior wood-board paneling complying with MMPA WM 9.

Retain one of four options in "Species" Subparagraph below or revise to suit Project.

1. Species: [**Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine**] [**Southern pine**] [**Western red cedar**] [**Figured red gum**] <Insert species>.

Retain one of five options in "Grade" Subparagraph below.

2. Grade: [**Clear No. 1**] [**Clear No. 2**] [**Knotty No. 1**] [**Knotty No. 2**] [**Finger jointed**].

First option in "Maximum Moisture Content" Subparagraph below is typical requirement of grading agencies for kiln-dried softwood moldings and molding stock. Second option is based on MMPA requirement for hardwood moldings.

3. Maximum Moisture Content: [**15 percent with at least 85 percent of shipment at 12 percent or less**] [**9 percent**].

Retain one of four options in "Pattern" Subparagraph below or revise to suit Project. See MMPA WM 9.

4. Pattern: [**V-joint, tongue and groove, PT 82**] [**Beaded ceiling, PT 85**] [**Beveled-edge channel, shiplapped, PT 82**] [**As indicated**].

Sizes in "Net Coverage Width" Subparagraph below represent 6-, 8-, and 10-inch (150-, 200-, 254-mm) nominal widths.

5. Net Coverage Width: Not less than [**5-1/16 inches (128 mm)**] [**6-3/4 inches (171 mm)**] [**8-3/4 inches (222 mm)**].

Retain "Board Paneling" Paragraph below for softwood paneling graded according to, and made to, patterns of lumber-grading agencies.

- C. Board Paneling:

1. Species and Grade:
 - a. Eastern white pine; NeLMA or NLGA [**C Select**] [**D Select**] [**Finish or 1 Common**] [**Premium or 2 Common**].
 - b. Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA [**C Select (Choice)**] [**D Select (Quality)**] [**1 Common (Colonial)**] [**2 Common (Sterling)**].

Grading rules for eastern white pine are not the same as those for western pine, so requirements in first subparagraph below will vary somewhat among species.

- c. Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA [**C Select (Choice)**] [**D Select (Quality)**] [**Finish or 1 Common (Colonial)**] [**Premium or 2 Common (Sterling)**].
- d. Southern pine; SPIB [**B & B**] [**C & Btr**] [**No. 2**] Paneling.
- e. Western red cedar; NLGA, WCLIB, or WWPA [**Clear Heart**] [**Grade A**] [**Grade B**].

Maximum moisture content for seasoned or kiln-dried, board-size lumber varies, depending on species, grade, and grading agency. See the Evaluations.

2. Maximum Moisture Content: [**19**] [**15**] percent[**with at least 85 percent of shipment at 12 percent or less**].
3. Pattern:

Retain one of first four subparagraphs below or revise to suit Project.

- a. V-joint, tongue and groove, [**NeLMA EWP 4**] [**SPIB SPP 54**] [**or**] [**WWPA WP 4**].
- b. Pickwick, tongue and groove, [**NeLMA EWP 2**] [**SPIB SPP 52**] [**or**] [**WWPA WP 2**].
- c. Rounded-edge channel groove, tongue and groove, [**SPIB SPP 60**] [**or**] [**WWPA WP 6**].
- d. Edge and center bead, tongue and groove, [**NeLMA E & CB**] [**or**] [**WWPA E & CB Ceiling**].

Sizes in "Net Coverage Width" Subparagraph below represent 6-, 8-, and 10-inch (150-, 200-, 254-mm) nominal widths.

4. Net Coverage Width: Not less than [**5-1/16 inches (128 mm)**] [**6-3/4 inches (171 mm)**] [**8-3/4 inches (222 mm)**].

2.4 MISCELLANEOUS MATERIALS

Retain materials in this article to suit Project.

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

Aliphatic-resin glues in "Glue" Paragraph below are sold as "carpenter's wood glue"; polyurethane, as "gorilla glue"; and resorcinol glues, as "waterproof plastic resin glue."

- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- C. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.

Retain "Multipurpose Construction Adhesive" Paragraph below if required.

- D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
 - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 INSTALLATION OF STANDING AND RUNNING TRIM

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
 - 1. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
 - 2. Stagger joints in adjacent and related standing and running trim.
 - 3. Cope or Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Use scarf joints for end-to-end joints.
 - 5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

Consider deleting first subparagraph below. Match of color and grain is subject to interpretation; below may be difficult to enforce.

- 6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.

7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

3.4 INSTALLATION OF PANELING

Retain paneling types in this article to suit Project.

- A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels.
 1. Leave **1/4-inch (6-mm)** gap to be covered with trim at top, bottom, and openings.
 2. Install with uniform tight joints between panels.
 3. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners.
 4. Space fasteners and adhesive as recommended by panel manufacturer.
 5. Conceal fasteners to greatest practical extent.

Retain subparagraph below if using grooved panels.

6. Arrange panels with grooves and joints over supports.
 - a. Fasten to supports with nails of type and at spacing recommended by panel manufacturer.
 - b. Use fasteners with prefinished heads matching groove color.
- B. Hardboard Paneling: Install according to manufacturer's written instructions.
 1. Leave **1/4-inch (6-mm)** gap to be covered with trim at top, bottom, and openings.
 2. Butt adjacent panels with moderate contact.
 3. Use fasteners with prefinished heads matching paneling color.

Retain "Wood Stud or Furring Substrate" and "Plaster or Gypsum-Board Substrate" subparagraphs below if required.

4. Wood Stud or Furring Substrate: Install with **1-inch (25-mm)** annular-ring shank hardboard nails.
5. Plaster or Gypsum-Board Substrate: Install with **1-5/8-inch (41-mm)** annular-ring shank hardboard nails.
6. Nailing: Space nails **4 inches (100 mm)** o.c. at panel perimeter and **8 inches (200 mm)** o.c. at intermediate supports unless otherwise required by manufacturer.
- C. Board Paneling: Install according to manufacturer's written instructions.
 1. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.

Retain first subparagraph below if end joints are unacceptable; second subparagraph, if acceptable.

2. Install in full lengths without end joints.

3. Stagger end joints in random pattern to uniformly distribute joints on each wall.

Retain one of first two subparagraphs below if retaining last subparagraph above. First below is for tongue-and-groove pattern; second, for other patterns.

4. Install with uniform end joints with only end-matched (tongue-and-groove) joints within each field of paneling.
5. Install with uniform end joints. Locate end joints only over furring or blocking.
6. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards.
7. Install with uniform tight joints between boards.

Retain one of five subparagraphs below.

8. Fasten paneling by face nailing, setting nails, and filling over nail heads.
9. Fasten paneling with trim screws, set below face and filled.
10. Fasten paneling by blind nailing through tongues.
11. Fasten paneling with paneling system manufacturer's concealed clips.
12. Fasten paneling to gypsum wallboard with panel adhesive.

END OF SECTION 062023

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Interior standing and running trim.
2. Wood-veneered cabinets and woodwork.
3. Plastic-laminate cabinets and shelving.
4. Solid-surfacing-material countertops and sinks.
5. Shop finishing of interior woodwork.
6. Custom millwork.

- B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. I001 "Color and Finish Legend" for owner approved, basis-of-design selections.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
- B. MDF: Medium Density Fiberboard.
- C. ABS: Acrylonitrile Butadiene Styrene
- D. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.
 1. Ends of cabinets, including those installed directly against walls or other cabinets are defined as "exposed."

2. Ends of cabinets indicated to be installed directly against and completely concealed by walls or other cabinets are defined as "concealed."
 3. Interior surfaces of open bookcases are defined as "exposed".
- E. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cabinets 78 inches or more above floor are defined as "semi-exposed."
- F. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.
- G. Hardwood Plywood: Panel product composed of layers or plies of veneer or of veneers in combination with lumber core, hardboard core, MDF core or particleboard core, joined with adhesive and faced both front and back with hardwood veneers.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.
- B. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate solid-surfacing material fire-retardant-treated materials cabinet hardware and accessories and finishing materials and processes.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- C. Shop Drawings: Show location of each item, dimensioned plans, elevations, sections, details, and attachments to other work.
1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 2. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
 3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 4. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other equipment.
 5. Indicate locations of hardware and keying of locks.
- D. Samples for Initial Selection:
1. Shop-applied transparent finishes.
 2. Shop-applied opaque finishes.
 3. Plastic laminates.
 4. ABS edge material.
 5. Thermoset decorative panels.
 6. Solid-surfacing materials.

- E. Samples for Verification: Unless otherwise directed, approved full size Samples may become part of completed Work, if in an undisturbed condition at time of Substantial Completion. Notify Architect of their exact locations. If not incorporated into Work, retain acceptable full size Samples at Project site and remove when directed by Architect.
1. Lumber with or for transparent finish, not less than 6 by 6 inches, for each species and cut, finished on 1 side and 1 edge.
 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
 3. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
 4. Thermoset decorative-panels, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with edge banding on 1 edge.
 5. Solid-surfacing materials, 6 inches (150 mm) square.
 6. One (1) full size, finished base cabinet complete with hardware, doors, and drawers.
 7. One (1) Sample each of hinged and sliding doors, if applicable to project.
 8. One (1) of each type of hardware item specified.
 - a. Sample submittal not required if specified product is submitted.
 9. Exposed cabinet hardware and accessories, one unit for each type and finish.
- F. Product Certificates: For each type of product, signed by product manufacturer.
- G. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- H. Qualification Data: For Installer/fabricator.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
1. Provide AWI Quality Certification Program labels and certificates indicating that millwork, including installation, complies with requirements of grades specified. **Project does not need to be AWI Certified.**
- E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by

testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

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

1.8 COORDINATION

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
2. Low Emitting Materials: Provide manufactured casework, including countertops, made with adhesives and composite wood products containing no added urea formaldehyde.

B. Wood Species and Cut for Transparent Finish: Red oak, rift cut.

1. Lumber materials for exposed wood cabinet surfaces: Red oak grade FAS or better, air dried and kiln dried to 6 percent moisture content, then tempered to 7-8 percent prior to fabrication. Red oak exposed to view to be free of stains, splits, shakes, season checks, and other similar defects.
2. Lumber materials for semi- exposed and concealed wood cabinet surfaces: Other hardwoods, grade FAS or better, air dried and kiln dried to 6 percent moisture content, then tempered to 7-8 percent prior to fabrication. Other hardwoods are used in semi-exposed, or, unexposed, areas and comply with NHLA grading for FAS or better lumber.

C. Wood Species for Opaque Finish: Any closed-grain hardwood.

D. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4, service tempered and consisting of steam-exploded wood fibers, highly compressed into a hard, dense, ¼ inch thick, homogeneous sheet, using natural resins and other added binders. Physical properties: Average modulus of rupture is 5,300-lbs. /sq. inch; density is 50 to 60 lbs. /cu. foot; and tensile strength of 3,500 lbs. /sq. inch.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
4. High Performance Particle Board Core:
 - a. Particleboard to be 47 lb. density of balanced 3 ply construction with moisture content not to exceed 8 percent. Particleboard shall conform to ANTI A208.1 1993, Type M 3.
 - b. Particleboard cabinet components for plastic laminate cabinets to be of the following minimum core thicknesses prior to lamination:
 - 1) 3/8 inch cabinet backs.
 - 2) 1/2 inch dividers, as detailed.
 - 3) 3/4 inch base and tall cabinet tops and bottoms, cabinet sides, door, cabinet back rear hang strips, dividers, exposed cabinet backs.
 - 4) 1 inch wall cabinet tops and bottoms, door cabinet shelving 30 inch width and over, and off wall shelving of all widths.
5. Softwood Plywood: DOC PS 1, Medium Density Overlay (MDO).

E. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

1. Provide ABS edge banding on components with exposed or semiexposed edges.

- F. 3mm and 1mm thick ABS Edge Banding. Solid, high impact, purified, color thru, acid resistant, pre-lamination primed edging, machine applied with hot melt adhesives, automatically trimmed, inside/outside length radiused for uniform appearance, buffed and corner radiused for consistent design. Colors shall be selected from manufacturer's full range. Minimum of one different color for each laminate color.
1. Basis of Design Product: Wilsonart ABS Edgeband or Architect approved equal.
 - a. Colors: TBD. Allow for a minimum of one color for each laminate selection.
 2. Edging locations: Provide above specified edging at the following locations:
 - a. Cabinet Door/Drawer front edge: 3mm.
 - b. Cabinet body edge, including door/drawer front spacer rail: 3mm.
 - c. Interior body component edging, interior dividers, top of drawer body, all four sides of all shelving: 1mm.
 - d. Countertop edges, front, and exposed ends: 3mm.
- G. Edging for wood cabinets:
1. Red oak, 3/8 inch thick or as noted below. 3mm thickness or any other dimensions less than specified will not be accepted.
- H. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nevamar Company, LLC; Decorative Products Div.
 - b. Wilsonart International; Div. of Premark International, Inc.
 - c. Formica Corporation.
 - d. Arborite; Division of ITW Canada, Inc.
 2. High pressure plastic laminate, .030 inch thickness, for vertical exposed cabinet surfaces shall meet NEMA LD3 1991 GP28 standards including thickness.
 - a. Colors: As indicated in Finish Legend in Drawings.
 3. Plastic Laminate Balancing Sheet: White high pressure cabinet liner, .020 inch thickness shall meet NEMA LD3 1991 CL 20 standards. Use for balancing exterior surface laminates.
 4. Countertop High Pressure Plastic Laminate:
 - a. High pressure plastic laminate, .050 inch thickness.
 - 1) Color: As indicated in Finish Legend on Drawings.
 - b. Heavy gauge neutral colored backing sheet for balanced construction. Exposed undersides shall be .020 White Liner.
 5. Pressure Fused Laminate:
 - a. Melamine resin impregnated, 80 gram PSM minimum, surface laminated to core under pressure.
 - b. Shall meet NEMA LD3.3 1991 GP28 standards and NEMA LD3 1991 CL20 standards.
 - c. Shall be used for semi-exposed surfaces.

- d. Shall be balanced at all concealed surfaces with phenolic backer. Unsurfaced core board not allowed.
- I. Solid-Surfacing Material: Homogeneous solid sheets of cast filled acrylic, not coated, laminated or of composite construction, meeting ANSE Z124-1980, Type Six.
1. Superficial damage to a depth of 0.10 of an inch shall be repairable by sanding or polishing.
 2. Manufacturers: Subject to compliance with requirements, provide products by **E.I. du Pont de Nemours and Company (Corian)** or comparable product by one of the following:
 - a. Wilsonart Engineered Surfaces.
 - b. LG Hi-Macs
 - c. Formica
 3. Colors: As indicated on Finish Legend on Drawings.
 4. Type: Standard.
 - a. Countertops: 1/2 inch material.
 5. Integral Sinks:
 - a. Basis of Design for ADA Compliant Lavatory: Dupont Corian model 810
 - 1) Bowl size: 16-1/2 inches by 13-1/8 inches by 5-3/8 inches.
 6. Accessory Products:
 - a. Joint adhesive: Manufacturer's standard two part adhesive kit to create inconspicuous, non-porous joints.
 - b. Panel Adhesive: Manufacturer's standard neoprene-based panel adhesive meeting ANSI A136.1-1967 and UL listed.
 - c. Sealant: Manufacturer's standard mildew resistant FDA/UL recognized silicone sealant in colors matching components.
- J. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.
1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:
1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
 2. Interior Type A: Low-hygroscopic formulation.
 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking plant certified by testing and inspecting agency.
 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
 5. Kiln-dry materials before and after treatment to levels required for untreated materials.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.
 2. For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.
 3. Product: Subject to compliance with requirements, provide "Duraflake FR" by Weyerhaeuser or comparable product.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
1. Product: Subject to compliance with requirements, provide "Meditate FR" by SierraPine Ltd.; Medite Div or comparable product.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General:
1. Provide cabinet hardware and accessory materials associated with architectural cabinets.

2. Hardware Finish: Brushed Chrome, unless otherwise noted.
- B. Hinges: Provide 2 hinges for doors up to 36 inches high. Provide 3 hinges for doors up to 60 inches high. Provide 4 hinges for doors up to 84 inches high.
1. Typical Hinges: Concealed European hinges.
 - a. Basis of Design Product: **Salice Series M**, 270 degree, 3 knuckle, grade 1 institutional hinge with integrated stay close device, constructed of die cast zinc with bright nickel finish and complying with BHMA A156.9 or comparable product.
- C. Pulls/ Handles:
1. specialty Pull for wall and base cabinets:
 - a. Basis of Design Product: **Richelieu Contemporary Metal Pull #5632** 5 1/32 inch pulls, Brushed Oil-Rubbed Bronze finish or comparable product.
 - b. 1 pull on drawings less than 27 inches wide and 2 pulls on drawers 27 inches wide and larger.
 2. Tall Cabinets: 3-point locking systems consisting of dummy handle on left hand door and 3- point locking handle on right door, providing positive latching engagement at top, bottom and middle of door. Rod ends for 3- point system extend into cabinet body and have a steel plate guide to protect the anchoring hole from wear. Exterior handle finishes in either satin chrome or black as directed by Architect.
- D. Catches: Magnetic Catches.
1. Basis of Design Product: **KV 918 ALUM Heavy- Duty Aluminum Magnetic Catch**, 2-1/16 inches by 1 inch, pull strength of approximately 7 pounds, aluminum finish. Screw-mounted catch and strike plate have slotted holes for adjustability, or comparable product.
 2. Doors up to 36 inches high: one catch each.
 3. Doors 36 inches high and over: two catches, located top and bottom.
- E. Adjustable Shelf Standards and Supports: Heavy- duty steel
1. Basis of Design Product: **KV Series 82 Heavy- Duty Standards and 182 Series Heavy-Duty Brackets** or comparable product.
 - a. BHMA Grade 2
 - b. Powder- coat finish
 - c. 16 gauge steel brackets, 14 gauge steel standards
 - d. Adjustable on 1 inch centers.
 - e. Height: As indicated in Drawings
- F. Shelf Clips: Clear Polycarbonate, laboratory standard grade, double ¼ inch diameter pins, 32mm on center, equipped with shelf lock hold down tabs for ¾ inch or 1 inch thick shelves. Clips should accommodate interchanging of shelves and thicknesses if desired by Owner.
- G. Drawer Slides: BHMA A156.9, B05091.
1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
 - a. Basis of Design Product: **Accuride model #3832** or comparable product.
 - b. 100 pound load capacity
 2. File Drawer Slides: Side mounted; full-extension type; zinc-plated steel ball-bearing slides.

- a. Basis of Design Product: **Accuride model #4034** or comparable product.
 - b. 150 pound load capacity
 - c. Slides shall have positive stops to prevent drawer's accidental removal, but allow for quick removal without tools.
- H. File Folder Drawer Inserts: Frames for fastening to drawer interior for hanging file folders
1. File Drawer Inserts:
 - a. Basis of Design Product: **Hafele File Frame Kit 422.74.310** or comparable product.
 - b. Applicable for letter size folders
 - c. Provide at all file drawer and lateral file drawers.
- I. Locks: Cylinder type, die- cast, five disc tumbler mechanism with removable core.
1. Basis of Design Product: CompX National or equal
 2. Provide locks at all locations, unless noted otherwise.
 3. **Keys and master key as directed by the Owner and Architect.**
 4. Provide 3 core keys so that facility may switch out locks as required.
 5. Provide two keys for each lock.
- J. Closet Rods:
1. Basis of Design Product: KV model 880 Extra- Duty Oval Closet Rod and 881 Flange
- K. Grommets for Cable Passage through Countertops: Metal grommets and matching caps with slot for wire passage.
1. Basis of Design Product: Subject to compliance with requirements, provide **Brava series BRV2 by Doug Mockett & Company, Inc.** or comparable product.
 - a. Finish: Satin Chrome
 - b. Brush Opening
 - c. 3-15/32 inches
 - d. Locations: Provide at all worksurface locations not more than 4' – 0" on center.
- L. Surface- Mount Counter Support Brackets:
1. Basis of Design Product: **EH Series by Rakks** or comparable product.
 - a. Provide EH-1824 for 30 inch deep counters
 - b. Provide EH-1818 for 24 inch deep counters
 - c. Provide EH-1212 for 18 inch deep counters
 - d. Colors: As selected by Architect from manufacturer's full range.
 - e. Weight Capacity: 450 pounds
 - f. Spacing: 32 inches on center maximum.
- M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 2. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
 3. Satin Stainless Steel: BHMA 630.
- N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

- O. Wall Hooks (WH1):
 - 1. Basis of Design Product: **Doug Mockett & Company Inc. CH53 Square Plate Coat Hook**, or equal.
 - a. Dimensions: 3-3/4" high x 2-3/4" wide with no more than 2-1/2" projection.
 - b. Finish: Satin Chrome.
 - c. Weight Capacity: 35 lbs minimum.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- D. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- E. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Contact Adhesive: 250 g/L.

2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of openings in countertops with a coat of varnish.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Custom.
- B. Wood Species and Cut: Red Oak, plain sliced.
 1. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
- C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
- D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
- E. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- F. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- G. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.
- H. For trim items wider than available lumber, use veneered construction. Do not glue for width.

2.7 PLASTIC-LAMINATE CABINETS

- A. Grade: Custom.
- B. AWI Type of Cabinet Construction: Flush overlay.
 1. Reveal Dimension: 3/8 inch reveals between doors and drawers that are adjacent.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade VGP.
 4. Edges: ABS edgebanding.
- D. Grain Direction for Wood Grain Plastic Laminate:
1. Vertical on doors, horizontal on drawer fronts.
 2. Lengthwise on face frame members.
 3. Vertical on end panels.
 4. Side to side on bottoms and tops of units.
 5. Vertical on knee-space panels.
 6. Horizontal on aprons.
- E. Construction: Provide laminate faced Casework of the following minimum construction:
1. Base Cabinets: 24 inches deep, unless otherwise noted.
 2. Overhead Wall Mounted Cabinets: 12 inches deep, unless otherwise noted.
 3. Bottoms of base cabinets and tall cabinets: 3/4 inch thick hardwood plywood.
 4. Bottoms of wall and upper case: 1 inch thick.
 5. Tops and Bottoms of Wall Cabinets and Tops of Tall Cabinets: 1 inch thick.
 - a. Bottoms: Exposed pocket shoulder screws are not acceptable.
 6. Ends of Cabinets: 3/4 inch thick.
 7. Shelves: 1 inch thick.
 8. Full Base Cabinet Top Frames:
 - a. Horizontal front top rail: 1 x 3 inches. Attach to cabinet ends with glued 8mm dowel joinery and screws.
 - b. Vertical back top rail: 3/4 x 3-3/4 inch. Attach to cabinet ends with glued 8mm dowel joinery and screws.
 - c. Top side rails: 3/4 x 1-1/2 inch between front horizontal and back vertical rails, glued and screwed in place.
 9. Wall, upper and tall case tops: 1 inch thick.
 10. Base cabinet front horizontal intermediate rail: 3/4 x 1-1/2 inch rail to be provided between doors and drawers. Secure to cabinet end panels with glued 8mm dowel joinery.
 11. Backs: Backs that extend through the bottom panels are not acceptable.
 12. Exposed backs: 1/4 inch thick, recessed 7/8 inch and set into top, bottom and ends, sealed with hot melt glue process around entire perimeter of cabinet.
 13. Semi-exposed backs: 1/4 inch thick, recessed 7/8 inch and set into top, bottom and ends, sealed with hot melt glue process around entire perimeter.
 14. Concealed backs:
 - a. Cupboard units: One piece 3/16 inch thick hardboard, rabbeted into rear top rail for easy removal from inside of cabinet.
 - b. Drawer units: Removable 3/16 inch thick hardboard split back panels, rabbeted into top rail.
 - c. Sink units: Half height, one piece 3/16 inch thick hardboard, rabbeted into rear rail for easy removal from inside cabinet.
 15. Vertical dividers in combination cabinets: 1-1/2 inch thick panel glued and screwed in place, top and bottom.
 16. Toe space rail: 3-3/4 x 3/4 inch, mounted between end panels with glued 8mm dowel joinery and metal fasteners, forming a 4 high x 2-1/2 inch deep toe space, closed to cupboard bottom.

17. Drawer Fronts: 3/4 inch thick.
 18. Drawer Sides and Backs: Four- sided drawer box with back, front and sides, 1/2 thick with chemical resistant finish and finished top edges. Sides shall be joined by multiple dovetail all four corners.
 19. Drawer Bottoms: 1/4 inch thick white coated MDF board, inset into all four sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter.
 20. Doors: 3/4 inch thick.
 21. Upper cabinet apron/ valance: for concealment of undercabinet lighting
 - a. 2 inches in height, thickness to match that of cabinet frame.
 - b. In locations where valances/ undercabinet lighting is noted in drawings, cabinet door height shall include the height of the cabinet body in addition to the height of the valance.
- F. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated appliances. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.
1. Provide utility space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.
 2. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.
 3. Provide knee space panels (modesty panels) at spaces between base cabinets, where cabinets are not installed against wall or where space is not otherwise closed. Fabricate from same material and with same finish as exposed cabinet backs

2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS (SSR)

- A. Grade: Custom.
- B. Solid-Surfacing-Material Thickness: 1/2 inch (13 mm).
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 1. As selected by Architect from manufacturer's full range.
- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
 2. Fabricate tops with loose backsplashes for field application.
- E. Install integral sink bowls in countertops in shop.
- F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.9 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.

- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing opaque-finished architectural woodwork.
- D. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing architectural woodwork not indicated to be shop finished.
- E. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. Refer to Division 09 painting Sections for material and application requirements.
- F. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- G. Transparent Finish:
 - 1. Grade: Custom.
 - 2. AWI Finish System: Conversion varnish.
 - a. Basis of Design Product: **M.L. Campbell KlearVar Conversion Varnish** or comparable product by:
 - 1) Sherwin Williams
 - 2) Benjamin Moore & Co
 - 3) PPG Paints
 - 3. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 - 4. Sheen:
 - a. Wood Cabinets: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.
 - b. Standing and Running Trim: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.
- H. Transparent Finish:
 - 5. Grade: Custom.
 - 6. AWI Finish System: Acrylic Polyurethane.
 - a. Basis of Design Product: **M.L. Campbell Polarion 2K Acrylic Polyurethane** or comparable product by:
 - 1) Sherwin Williams

- 2) Benjamin Moore & Co
- 3) PPG Paints
7. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
8. Sheen:
 - a. Wood Veneer Panels: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).
- H. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Do not exceed the following tolerances:
 - a. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - b. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
 - c. Variation of Faces of Cabinets from True Plane: 1/8 inch in 10 feet.
 - d. Variation of Adjacent Surfaces from True Plane (Lippage): 1/32 inch.
 - e. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips and No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
 3. Base Cabinets: Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - a. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 16 inches o.c. and at sides of cabinets with not less than 2 fasteners per side.
- I. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
 5. Field Jointing: Where possible, make in same manner as shop made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field made joints.
 6. Use concealed clamping devices for field made joints in plastic laminate countertops. Locate clamping devices within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert uniform heavy pressure at joints.
 7. Fastening: Secure countertops to cabinets with "Z" Type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
 8. Provide required holes and cutouts for service fittings.
 9. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and

finish to adjacent Institutional Casework. Use chemical resistant, permanently elastic sealing compound where recommended by manufacturer.

10. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

- J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- K. Refer to Division 09 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING

- A. Adjust cabinets and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately.
- B. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- C. Protect countertop surfaces during construction with 6 mil plastic or other suitable water resistant covering. Tape to underside of countertop at minimum of 48 inches o.c.
- D. Clean, lubricate, and adjust hardware.
- E. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Research reports.

C. Field quality control reports.

1.4 CLOSEOUT SUBMITTALS

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Installer Qualifications: Manufacturer of products.

1.6 FIELD CONDITIONS

- A. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless unless noted otherwise on drawings.
- D. Door and Drawer-Front Style: Flush overlay unless noted otherwise on drawings.
 - 1. Reveal Dimension: ¼”
- E. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.
 - 1. Wilsonart
 - 2. Formica
 - 3. Panolam
- F. Exposed Surfaces:
 - 1. Plastic-Laminate Grade: HGS.
 - 2. Edges: Grade HGS
 - 3. Pattern Direction: As indicated.
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

- I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 1. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, [gloss] [matte] finish.
 - b. Solid colors with core same color as surface, [gloss] [matte] finish.
 - c. Wood grains, [gloss] [matte] finish.
 - d. Patterns, [gloss] [matte] finish.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 1. Softwood Plywood: DOC PS 1, medium-density overlay.
 2. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of ISO 4586.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 100 degrees of opening, self-closing.
- B. Drawer Slides: ANSI/BHMA A156.9.
 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
 - a. Type: Full overtravel extension.
 - b. Material: Galvanized steel ball bearing slides.
 - c. Motion Feature: Soft close dampener.
- C. Door Locks: ANSI/BHMA A156.11, E07121.
- D. Drawer Locks: ANSI/BHMA A156.11, E07041.
- E. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- F. Grommets for Cable Passage: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Color: As selected by Architect from Manufacturers full range.

- G. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Architect's sample.
 2. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
 3. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
 4. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
 5. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
 6. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
 7. Satin Stainless Steel: ANSI/BHMA 630.
- H. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Type I, waterproof type selected by fabricator to comply with requirements.
1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.5 FABRICATION

- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips

3.2 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity is to prepare and submit report of inspection.

END OF SECTION 064116

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Cold-applied rubberized asphalt waterproofing.
 2. Molded-sheet drainage panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Review waterproofing requirements including, but not limited to, the following:
 - a. Surface preparation specified in other Sections.
 - b. Minimum curing period.
 - c. Forecasted weather conditions.
 - d. Special details and sheet flashings.
 - e. Repairs.
 - f. Field quality control.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings:
1. Indicate locations and extent of waterproofing.
 2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples: For each exposed product and for each color and texture specified, including the following products:
1. Flashing sheet, 8 by 8 inches (200 by 200 mm).
 2. Membrane-reinforcing fabric, 8 by 8 inches (200 by 200 mm).
 3. Drainage panel, 4 by 4 inches (100 by 100 mm).

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.
 - 1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
 - 2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

- 1. Warranty Period: One year from date of Purchase.

PART 2 - PRODUCTS

2.1 ASPHALT WATERPROOFING

- A. Single-Component, Rubberized Asphalt Waterproofing: Water-based, polymer-modified rubberized asphalt complying with ASTM C836/C836M, with the following properties measured in accordance with standard test methods referenced:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **Dorkin Systems Inc. Delta MS** or a comparable product by one of the following:
 - 1. DamPro
 - 2. Polyguard
 - 3. Water Vapor Permeance: 0.03 perm (1.72 ng/Pa x s x sq.m), maximum, ASTM E96/E96M.
 - 4. Hydrostatic-Head Resistance: 100 psi (690 kPa) average; ASTM D5385.

2.2 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.
 - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.
- C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
 - 1. Adhesive: Manufacturer's recommended contact adhesive.
- D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; as specified in Section 079200 "Joint Sealants"; and as recommended by manufacturer for substrate and joint conditions.
 - 1. Backer Rod: Closed-cell polyethylene foam.

2.3 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Collector-Panel System: Composite subsurface collector-panel system by same manufacturer as primary molded-sheet drainage panels; consisting of a high-profile, studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.425 mm) sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 15 gpm per ft. (112 to 188 L/min. per m) and a horizontal, in-plane flow rate of 10 to 13 gpm per ft. Provide system with manufacturer's outlets, connectors, tapes, and other accessories to connect primary molded-sheet drainage panels with piped subdrainage system specified in Section 334600 "Subdrainage."
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **Dorkin Systems Inc. Delta MS** or a comparable product by one of the following:
 - 1. DamPro.
 - 2. Polyguard.
 - 3. NDS.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates in accordance with manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

- A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C1471/C1471M.
- B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C1471/C1471M. Before coating surfaces, remove dust and dirt from joints and cracks in accordance with ASTM D4258.
 1. Comply with ASTM C1193 for joint-sealant installation.
 2. Apply bond breaker on sealant surface, beneath preparation strip.
 3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
 4. Extend sheet flashings for 4 inches (100 mm) onto perpendicular surfaces and items penetrating substrate.

3.5 INSTALLATION OF WATERPROOFING

- A. Apply waterproofing in accordance with manufacturer's written instructions and to recommendations in ASTM C1471/C1471M.
- B. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.
- C. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
 - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils (1.5 mm).
 - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
 - 3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
- D. Cure waterproofing, taking care to prevent contamination and damage during application and curing.
- E. Install protection course with butted joints over waterproofing before starting subsequent construction operations.
 - 1. For horizontal applications, install protection course loose laid over fully cured membrane.
 - 2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.
 - 3. Molded-sheet drainage panels may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

3.6 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, in accordance with manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
- B. Molded-Sheet Collector-Panel System: Install in accordance with manufacturer's written instructions. Connect to piped subdrainage system specified in Section 334600 "Subdrainage."

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections:
 - 1. Testing agency to verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) of installed waterproofing or part thereof.

- B. Waterproofing will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION 071416

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrating water repellents.

B. Related Requirements:

1. Section 040310 "Historic Masonry Cleaning".

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Penetrating water repellents.

B. Product Data Submittals:

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

- C. Samples: For each type and color of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Applicator.

- B. Product Certificates: For each type of water repellent.

- C. Preconstruction Test Reports: For water-repellent-treated substrates.

- D. Field quality-control reports.

- E. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, for preconstruction testing, and to set quality standards for materials and execution.
 - 1. Locate mockups in locations that enable viewing under same conditions as the completed Work.
 - a. Size: 4 ft. by 4ft. each.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing of water repellents on field mockups.
 - 1. In addition to verifying performance requirements, use mockups to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrates.
 - 2. Propose changes to materials and methods to suit Project.
 - 3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.7 FIELD CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied in accordance with manufacturers' written instructions and warranty requirements:
 - 1. Concrete surfaces and mortar have cured for not less than 28 days.
 - 2. Building has been closed in for not less than 30 days before treating wall assemblies.
 - 3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
 - 4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
 - 5. Rain or snow is not predicted within 24 hours.
 - 6. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.8 WARRANTY

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance: Water repellents must meet the following performance requirements as determined by testing on manufacturer's standard substrates representing those indicated for this Project.
- B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
 1. Clay Brick: ASTM C67.
 2. Natural Stone: ASTM C97/C97M.
- C. Water-Vapor Transmission: Comply with one or both of the following:
 1. Maximum WVT (grains/h ft²) 2.58; Permeance 6.27, in accordance with ASTM D 6490.
- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, in accordance with ASTM E514/E514M.
- E. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering in accordance with ASTM G154 compared to water-repellent-treated specimens before weathering.

2.2 PENETRATING WATER REPELLENTS

- A. Penetrating Low-VOC Siloxane Water Repellent: Clear, containing 10 percent or more active content of modified siloxane; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
 1. Prosoco Natural Stone Treatment (**Basis of Design**).
 2. Diedrich Technologies.
 3. Sika USA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry in accordance with water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level in accordance with water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, in accordance with repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product in accordance with water-repellent manufacturer's written instructions.
- C. Retain one or more of four subparagraphs below to suit Project. Last option in first subparagraph below may be unsuitable for surfaces that require historic treatment.
1. Natural Stone: Section 040310 "Historic Masonry Cleaning."
- D. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- E. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- F. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION OF WATER REPELLENTS

- A. Apply coating of water repellent on surfaces to be treated using 15 psi- (103 kPa-) pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

- B. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

- A. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
 - 1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
 - 2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mineral-wool blanket insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Mineral-wool blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.
- B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.
- C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MINERAL-WOOL BLANKET INSULATION

- A. Mineral-Wool Blanket Insulation, Unfaced : ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
 - 1. Owens Corning
 - 2. Rockwool
 - 3. Johns Mansville

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
3. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 6. For wood-framed construction, install blankets according to ASTM C1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100

SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Metal flashing and trim.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Asphalt roofing cement.
5. Elastomeric flashing sealant.

- B. Shop Drawings: For metal flashing and trim.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports for synthetic underlayment.
- C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.7 WARRANTY

- A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
 - 1. Materials Warranty Period: 50 years from date of Substantial Completion, prorated, with first 10 years nonprorated.
 - 2. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to **110 mph (49 m/s)** for **15** years from date of Substantial Completion.
 - 3. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 10 years from date of Substantial Completion.
 - 4. Workmanship Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
- B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
 - 1. Manufacturers
 - a. Certainteed
 - b. GAF
 - c. Owens Corning
 - 2. Butt Edge: Straight cut.
 - 3. Strip Size: Manufacturer's standard.
 - 4. Algae Resistance: Granules resist algae discoloration.
 - 5. Color and Blends: As selected by Architect from manufacturer's full range.

2.3 UNDERLAYMENT MATERIALS

- A. Organic Felt: Asphalt-saturated organic felts, nonperforated and complying with the following:
 - 1. ASTM D4869/D4869M: Type III.

2.4 RIDGE VENTS

- A. Rigid Ridge Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use under ridge shingles.
 - 1. Features:
 - a. Nonwoven geotextile filter strips.
 - b. External deflector baffles.

2.5 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.
- B. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.
- C. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum **0.120-inch- (3-mm-)** diameter, sharp-pointed, with a **3/8- to 7/16-inch- (10- to 11-mm-)** diameter flat head and of sufficient length to penetrate **3/4 inch (19 mm)** into solid wood decking or extend at least **1/8 inch (3 mm)** through sheathing less than **3/4 inch (19 mm)** thick.
 - 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- D. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, **1-inch- (25-mm-)** minimum diameter.
 - 1. Provide with minimum **0.0134-inch- (0.34-mm-)** thick metal cap, **0.010-inch- (0.25-mm-)** thick power-driven metal cap, or **0.035-inch- (0.89-mm-)** thick plastic cap; and with minimum **0.083-inch- (2.11-mm-)** thick ring shank or **0.091-inch- (2.31-mm-)** thick smooth shank of length to penetrate at least **3/4 inch (19 mm)** into roof sheathing or to penetrate through roof sheathing less than **3/4 inch (19 mm)** thick.

2.6 METAL FLASHING AND TRIM

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
 - 1. Sheet Metal: Anodized aluminum.

- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise indicated on Drawings.
 - 1. Vent-Pipe Flashings: ASTM B749, Type L51121, at least **1/16 inch (1.6 mm)** thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least **4 inches (102 mm)** from pipe onto roof.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT MATERIALS

- A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.
- B. Asphalt-Saturated Felt: Install on roof deck parallel with and starting at eaves and fasten with underlayment nails.
 - 1. Single-Layer Installation:
 - a. Lap sides a minimum of **2 inches (51 mm)** over underlying course.
 - b. Lap ends a minimum of **4 inches (102 mm)**.
 - c. Stagger end laps between succeeding courses at least **72 inches (1829 mm)**.
 - 2. Install felt underlayment on roof deck not covered by self-adhering, polymer-modified bitumen sheet unless otherwise specified in this Section or indicated on Drawings.
 - a. Lap sides of felt over self-adhering sheet not less than **4 inches (102 mm)** in direction that sheds water.
 - 3. Terminate felt extended up not less than **4 inches (102 mm)]** against sidewalls, curbs, chimneys, and other roof projections.
- C. Metal-Flashed, Open-Valley Underlayment: Install two layers of minimum **36-inch- (914-mm-)** wide underlayment centered in valley.
 - 1. Use same underlayment as installed on field of roof.
 - 2. Stagger end laps between layers at least **72 inches (1829 mm)**.
 - 3. Lap ends of each layer at least **12 inches (305 mm)** in direction that sheds water, and seal with asphalt roofing cement.
 - 4. Fasten each layer to roof deck with underlayment nails located as far from valley center as possible and only to extent necessary to hold underlayment in place until installation of valley flashing.
 - 5. Lap roof-deck underlayment over first layer of valley underlayment at least **6 inches (152 mm)**.

3.2 INSTALLATION OF METAL FLASHING AND TRIM

- A. Install metal flashings and trim to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
 - 1. Install metal flashings in accordance with recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
 - 2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.
- B. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.3 INSTALLATION OF ASPHALT SHINGLES

- A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with self-sealing strip face up at roof edge.
 - 1. Extend asphalt shingles **3/4 inch (19 mm)** over fasciae at eaves and rakes.
 - 2. Install starter strip along rake edge.
- C. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt shingle strips with a minimum of five roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.
 - 1. Locate fasteners in accordance with manufacturer's written instructions.
 - 2. Where roof slope exceeds 18:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 - 3. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
 - 4. When ambient temperature during installation is below **50 deg F (10 deg C)** hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
- E. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley **12 inches (305 mm)]**beyond center of valley.
 - 1. Use one-piece shingle strips without joints in valley.
 - 2. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line **2 inches (51 mm)** short of valley centerline.

3. Trim upper concealed corners of cut-back shingle strips.
 4. Do not nail asphalt shingles within **6 inches (152 mm)** of valley center.
 5. Set trimmed, concealed-corner asphalt shingles in a **3-inch- (76-mm-)** wide bed of asphalt roofing cement.
- F. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- G. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.
1. Fasten with roofing nails of sufficient length to penetrate sheathing.
 2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 073113

SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal soffit panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

- B. Warranties: Samples of special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft. (0.3 L/s per sq. m)** when tested according to ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: **6.24 lbf/sq. ft. (300 Pa)**.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: **6.24 lbf/sq. ft. (300 Pa)**.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): **120 deg F (67 deg C)**, ambient.

2.2 METAL SOFFIT PANELS

- A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Reveal-Joint-Profile Metal Soffit Panels Solid panels formed with vertical panel edges and a flat pan between panel edges; with recessed reveal joint between panels.
 - 1. Aluminum Sheet: Coil-coated sheet, **ASTM B209 (ASTM B209M)**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: **0.040 inch (1.02 mm)**.
 - b. Surface: Smooth, flat finish.
 - c. Exterior Finish: Two-coat fluoropolymer
 - d. Color: Custom finish as determined by Architect
 - 2. Panel Coverage: Verify existing conditions in field.
 - 3. Panel Height: **1.5 inches (38 mm)**.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, **G90 (Z275)** hot-dip galvanized coating designation or ASTM A792/A792M, **Class AZ50 (Class AZM150)** aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; **1/8 inch (3 mm)** thick.
 - 2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
 1. Soffit Framing: Wire tie furring channels to supports, as required to comply with requirements for assemblies indicated.

3.2 INSTALLATION

- A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 1. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- B. Watertight Installation:
 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.

3. At panel splices, nest panels with minimum **6-inch (152-mm)** end lap, sealed with sealant and fastened together by interlocking clamping plates.
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074293

**SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS
MEMBRANE ROOFING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roof system.
2. Base sheet materials.
3. Interply sheets.
4. Styrene-butadiene-styrene (SBS)-modified bituminous cap sheet.
5. Base flashing sheet materials.
6. Asphalt materials.
7. Accessory roofing materials.
8. Roof insulation.
9. Insulation accessories and cover board.
10. Walkways.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav and SPRI's Directory of Roof Assemblies listing.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Crickets, saddles, and tapered edge strips, including slopes.
7. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
8. Tie-in with adjoining air barrier.

- C. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of complying with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

- B. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

- C. Research reports.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

- E. Field quality-control reports.

- F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: A qualified manufacturer that is UL listed, listed in FM Approvals' RoofNav and listed in SPRI's Directory of Roof Assemblies for roofing system identical to that used for this Project.

2. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane to resist impact damage when tested in accordance with ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 1. Fire/Windstorm Classification: Class 1A-90
 2. Hail-Resistance Rating: FM 1-34 MH.
- D. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and are listed in SPRI's Directory of Roof Assemblies for roof assembly identical to that specified for this Project.
 1. Wind Uplift Load Capacity: 75 psf.
- E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A for application and roof slopes indicated; testing by a qualified testing agency.
 1. Identify products with appropriate markings of applicable testing agency.
- F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.
 1. Identify products with appropriate markings of applicable testing agency.

2.2 MANUFACTURERS

- A. Styrene-Butadiene-Styrene (SBS)-Modified Bituminous Membrane Roof System: See the following articles for individual roof materials required.
1. Holcim Elevate/Firestone
 2. Johns Mansville
 3. GAF Roofing

2.3 SOURCE LIMITATIONS

- A. Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.

2.4 BASE SHEET MATERIALS

- A. SBS-Modified Bitumen Type I, Polyester-Mat Base Sheet: ASTM D6164/D6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

2.5 INTERPLY SHEETS

- A. Glass-Fiber Interply Sheet: ASTM D2178/D2178M, Type IV asphalt-impregnated, glass-fiber felt.

2.6 STYRENE-BUTADIENE-STYRENE (SBS)-MODIFIED BITUMINOUS CAP SHEET

- A. SBS-Modified Bitumen Type I, Polyester-Mat, Smooth-Surfaced Cap Sheet: ASTM D6164/D6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

2.7 BASE FLASHING SHEET MATERIALS

- A. SBS-Modified Bitumen Backer Sheet: ASTM D6164/D6164M, Type I or II, smooth surfaced, suitable for application method specified.
- B. SBS-Modified Bitumen Metal-Surfaced Flashing Sheet: ASTM D6298, metal-foil-surfaced SBS-modified asphalt sheet, reinforced with glass fibers, suitable for application method specified, and as follows:
1. Metal Surfacing: Aluminum
- C. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D1668/D1668M, Type I.

- D. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.8 ASPHALT MATERIALS

- A. Roofing Asphalt: ASTM D312/D312M, Type III or IV as recommended by roofing system manufacturer for application.
- B. SEBS-Modified Roofing Asphalt: ASTM D6152/D6152M.

2.9 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- C. Sheathing Paper: Red-rosin type, minimum **3 lb/100 sq. ft. (0.16 kg/sq. m)**.
- D. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately **1 by 1/8 inch (25 by 3 mm)** thick; with anchors.
- E. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.
- F. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- H. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.10 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2 felt or glass-fiber mat facer on both major surfaces.
 - 1. Size: **48 by 48 inches**
 - 2. Thickness: As required to achieve design R-Value. See Drawings for more information.
- B. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation

2. Minimum Thickness: **1/4 inch (6 mm)**.
3. Slope:
 - a. Roof Field: **1/4 inch per foot (1:48)** unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: **1/2 inch per foot (1:24)** unless otherwise indicated on Drawings.

INSULATION ACCESSORIES AND COVER BOARD

- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- D. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
- E. Insulation Cant Strips: ASTM C728, perlite insulation board
- F. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.
 1. Thickness: **1/2 inch (13 mm)**
 2. Surface Finish: Fiberglass facer

2.11 WALKWAYS

- A. Walkway Pads: Polymer-modified, reconstituted rubber pads with slip-resisting textured surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, **3/4 inch (19 mm)** thick, minimum.
 1. Pad Size: Approximately **36 by 60 inches (914 mm by 1524 mm)**
 2. Color: Contrasting with cap sheet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

3.2 PREPARATION

- A. Perform fastener-pullout tests in accordance with roof system manufacturer's recommendations.

1. Submit test result within 24 hours of performing tests.
 - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system in accordance with roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly and SPRI's Directory of Roof Assemblies listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.
 1. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.
- D. Asphalt Heating:
 1. Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.
 - a. For cap sheets, heat asphalt in accordance with cap sheet manufacturer's recommendations.
 2. Circulate asphalt during heating.
 3. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.
 - a. For cap sheets, comply with cap sheet manufacturer's recommendations.
 4. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.
 5. Do not heat asphalt within **25 deg F (14 deg C)** of flash point.
 6. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
 7. Apply hot roofing asphalt within plus or minus **25 deg F (14 deg C)** of equiviscous temperature.
 - a. For cap sheets, comply with cap sheet manufacturer's recommendations.
- E. SEBS-Modified Asphalt Heating: Heat and apply roofing asphalt in accordance with roofing system manufacturer's written instructions.

- F. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees.

D. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than **24 inches (600 mm)** in adjacent rows end joints staggered not less than **12 inches (300 mm)** in adjacent rows and with long joints continuous at right angle to flutes of decking.
 - a. Locate end joints over crests of decking.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than **1/4 inch (6 mm)** in width.
 - d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus **24 inches (600 mm)**.
 - 1) Trim insulation, so that water flow is unrestricted.
 - e. Fill gaps exceeding **1/4 inch (6 mm)** with insulation.
 - f. Cut and fit insulation within **1/4 inch (6 mm)** of nailers, projections, and penetrations.
 - g. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
 - 1) Fasten insulation in accordance with requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification and SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
 - 2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than **12 inches (300 mm)** from previous layer of insulation.
 - a. Staggered end joints within each layer not less than **24 inches (600 mm)** in adjacent rows.

- b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
- c. Make joints between adjacent insulation boards not more than **1/4 inch (6 mm)** in width.
- d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus **24 inches (600 mm)**.
- e. Trim insulation, so that water flow is unrestricted.
- f. Fill gaps exceeding **1/4 inch (6 mm)** with insulation.
- g. Cut and fit insulation within **1/4 inch (6 mm)** of nailers, projections, and penetrations.
- h. Adhere each layer of insulation to substrate using adhesive in accordance with FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1) of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus **25 deg F (14 deg C)** of equiviscous temperature.

E. Installation Over Wood Decking:

1. Mechanically fasten sheathing paper to roof deck using mechanical fasteners specifically designed and sized for fastening slip sheet to wood decks.
 - a. Lap edges a minimum of **2 inches (51 mm)**, or as recommended by roof membrane manufacturer.
 - b. Lap ends a minimum of **6 inches (150 mm)**, or as recommended by roof membrane manufacturer.
 - c. Fasten sheathing paper to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install base layer of insulation with joints staggered not less than **24 inches (600 mm)** in adjacent rows.
 - a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than **1/4 inch (6 mm)** in width.
 - d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus **24 inches (600 mm)**.
 - 1) Trim insulation, so that water flow is unrestricted.
 - e. Fill gaps exceeding **1/4 inch (6 mm)** with insulation.
 - f. Cut and fit insulation within **1/4 inch (6 mm)** of nailers, projections, and penetrations.

- g. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood decks.
 - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
- 3. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than **12 inches (300 mm)** from previous layer of insulation.
 - a. Staggered end joints within each layer not less than **24 inches (600 mm)** in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than **1/4 inch (6 mm)** in width.
 - d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus **24 inches (600 mm)**.
 - 1) Trim insulation, so that water flow is unrestricted.
 - e. Fill gaps exceeding **1/4 inch (6 mm)** with insulation.
 - f. Cut and fit insulation within **1/4 inch (6 mm)** of nailers, projections, and penetrations.
 - g. Adhere each layer of insulation to substrate using adhesive in accordance with SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

3.5 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of **6 inches (150 mm)** in each direction.
 - 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board, so that water flow is unrestricted.
 - 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 - 4. Adhere cover board to substrate using adhesive in accordance with FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus **25 deg F (14 deg C)** of equiviscous temperature.

- B. Install sheathing paper over cover board and immediately beneath roof membrane.

3.6 INSTALLATION OF ROOFING MEMBRANE, GENERAL

- A. Install roofing system in accordance with roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
- B. Start installation of roofing in presence of roofing system manufacturer's technical personne.
 - 1. Backnail roofing sheets to nailer strips in accordance with roofing system manufacturer's written instructions.
- C. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
 - 1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
 - 2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
 - 3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.7 INSTALLATION OF BASE SHEET

- A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.
- B. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of **2 inches (51 mm)** and **6 inches (150 mm)**, respectively.
- C. Installation of SBS-Modified Bitumen Polyester-Mat Base Sheet:
 - 1. Install base sheet in accordance with roofing manufacturer's written instructions, starting at low point of roofing system.
 - 2. Extend roofing sheets over and terminate above cants.
 - 3. Install base sheet in a shingle fashion.
 - 4. Adhere to substrate in a uniform coating of cold-applied adhesive.
 - 5. Mechanically attach base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening base sheet to wood decks.
 - a. Fasten base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.
 - 6. Install base sheet without wrinkles, rears, and free from air pockets.

7. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.
 - a. Lap side laps as recommended by roof membrane manufacturer but not less than **3 inches (76 mm)**.
 - b. Lap end laps as recommended by roof membrane manufacturer but not less than **12 inches (300 mm)**.
 - c. Stagger end laps not less than **18 inches (450 mm)**.
 - d. Completely bond and seal laps, leaving no voids.
 - e. Roll laps with a **20-pound (9-kg)** roller.
8. Repair tears and voids in laps and lapped seams not completely sealed.
9. Apply pressure to the body of the base sheet in accordance with manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

3.8 INSTALLATION OF INTERPLY SHEETS

- A. Install two ply sheets, starting at low point of roofing.
 1. Align ply sheets without stretching.
 2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.
 - a. Shingle in direction to shed water.
 3. Extend ply sheets over and terminate above cants.

3.9 INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET

- A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.
- B. Install modified bituminous roofing cap sheet in accordance with roofing manufacturer's written instructions, starting at low point of roofing system.
 1. Extend cap sheet over and terminate above cants.
 2. Install cap sheet in a shingle fashion.
 3. Install cap sheet as follows:
 - a. Adhere to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by cap sheet manufacturer.
 4. Install cap sheet without wrinkles or tears, and free from air pockets.
 5. Install cap sheet so side and end laps shed water.

- C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.
 - 1. Lap side laps as recommended by roof membrane manufacturer but not less than **3 inches (76 mm)**.
 - 2. Lap end laps as recommended by roof membrane manufacturer but not less than **12 inches (300 mm)**.
 - 3. Stagger end laps not less than **18 inches (450 mm)**.
 - 4. Completely bond and seal laps, leaving no voids.
 - 5. Roll laps with a **20-pound (9-kg)** roller.
 - 6. Repair tears and voids in laps and lapped seams not completely sealed.

- D. Apply pressure to the body of the cap sheet in accordance with manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

3.10 INSTALLATION OF FLASHING AND STRIPPING

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates in accordance with roofing system manufacturer's written instructions and as follows:
 - 1. Prime substrates with asphalt primer if required by roofing system manufacturer.
 - 2. Backer Sheet Application: Adhere backer sheet to substrate] in a solid mopping of hot roofing asphalt.
 - a. Seal all laps.
 - 3. Flashing Sheet Application, Hot: **Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by flashing sheet manufacturer. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.**

- B. Extend base flashing up walls or parapets a minimum of **8 inches (200 mm)** above roofing membrane and **4 inches (100 mm)** onto field of roofing membrane.

- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

- D. Install liquid flashing system in accordance with manufacturer's recommendations.
 - 1. Extend liquid flashing not less than **3 inches (76 mm)** in all directions from edges of item being flashed.
 - 2. Embed granules, matching color of roof membrane, into wet compound.

- E. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing in accordance with roofing system manufacturer's written instructions.

- F. Roof Drains: Set **30-by-30-inch- (760-by-760-mm-) 4-pound (1.8 kg)** lead flashing in bed of asphaltic adhesive on completed roofing membrane.

1. Cover lead flashing with roofing cap-sheet stripping, and extend a minimum of **6 inches (150 mm)** beyond edge of metal flashing onto field of roofing membrane.
2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping in accordance with roofing system manufacturer's written instructions.

3.11 INSTALLATION OF WALKWAYS

- A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size, in accordance with walkway pad manufacturer's written instructions.
1. Install walkways at the following locations:
 - a. Perimeter of each rooftop unit.
 - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
 - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
 - d. Top and bottom of each roof access ladder.
 - e. As required by roof membrane manufacturer's warranty requirements.
 2. Provide **3-inch (76-mm)** clearance between adjoining pads.
 3. Heat-weld to substrate or adhere walkway products to substrate with compatible adhesive in accordance with roofing system manufacturer's written instructions.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
1. Infrared Thermography: Testing agency surveys entire roof area using infrared color thermography in accordance with ASTM C1153.
 - a. Perform tests before overlying construction is placed.
 - b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection testing.
 - c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
 - 1) Cost of retesting is Contractor's responsibility.
 - d. Testing agency to prepare survey report of initial scan indicating locations of entrapped moisture, if any.

2. Electrical Capacitance/Impedance Testing: Testing agency surveys entire roof area for entrapped water within roof assembly in accordance with ASTM D7954/D7954M.
 - a. Perform tests before overlying construction is placed.
 - b. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.
 - 1) Cost of retesting is Contractor's responsibility.
 - c. Testing agency to prepare survey report indicating locations of entrapped moisture, if any.
 - C. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing system to comply with criteria established in Appendix 3 in ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."
 1. Repair areas where test cuts were made in accordance with roofing manufacturer's written instructions.
 - D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
 - E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
 - F. Roofing system will be considered defective if it does not pass tests and inspections.
 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 3.13 PROTECTING AND CLEANING
- A. Protect roofing system from damage and wear during remainder of construction period.
 1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
 - B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.
 - C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reglets and counterflashings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For tests performed by a qualified testing agency.
- B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class.

1.6 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075216, Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing.
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.

- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.
 1. Design Pressure: As indicated on Drawings.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): **120 deg F (67 deg C)**, ambient; material surfaces.

2.2 REGLETS AND COUNTERFLASHINGS

- A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
 1. Formed Aluminum: **0.050 inch (1.27 mm)** thick.
 2. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
- B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by **4 inches (100 mm)** and in lengths not exceeding [**12 feet (3.6 m)**] designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
 1. Formed Aluminum: **0.032 inch (0.81 mm)** thick.
- C. Accessories:
 1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
 2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- D. Aluminum Finish: Two-coat fluoropolymer.
 1. Color: As selected by Architect from manufacturer's full range.

2.3 MATERIALS

- A. Aluminum Sheet: **ASTM B209 (ASTM B209M)**, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

2.4 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum **30 to 40 mils (0.76 to 1.0 mm)** thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D1970/D1970M; stable after testing at **240 deg F (116 deg C)**.
 - 2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus **20 deg F (29 deg C)**.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
 - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
 - 2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel..
- B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.6 FINISHES

- A. Coil-Coated Aluminum Sheet Finishes:
 - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than **6 inches (152 mm)** staggered **24 inches (610 mm)** between courses. Overlap side edges not less than **3-1/2 inches (90 mm)**. Roll laps with roller. Cover underlayment within 14 days.
1. Apply continuously under reglets and counterflashings.
 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.2 INSTALLATION, GENERAL

- A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
 4. Torch cutting of roof specialties is not permitted.
 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of [**12 feet (3.6 m)**] with no joints within [**18 inches (450 mm)**] of corners or intersections unless otherwise indicated on Drawings.
 2. When ambient temperature at time of installation is between **40 and 70 deg F (4 and 21 deg C)**, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance

- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.3 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.
- B. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Roof hatches.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
- B. Shop Drawings: For roof accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Aluminum sheet **0.125 inch (3.17 mm)** thick.
 - 1. Finish: Two-coat fluoropolymer or Baked enamel or powder coat.
 - 2. Color: As selected by Architect from manufacturer's full range.
- D. Construction:
 - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. Fabricate curbs to minimum height of **12 inches (305 mm)** above roofing surface unless otherwise indicated.
 - 3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
 - 4. Insulation: Factory insulated with **1-1/2-inch- (38-mm-)** thick glass-fiber board insulation.
 - 5. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 6. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
 - 7. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
 - 8. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from **3/4-inch- (19-mm-)** thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
 - 9. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
 - 10. Security Grille: Provide where indicated.

2.2 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Bilco
 - 2. Babcock Davis
 - 3. Acudoor
- B. Type and Size: Single-leaf lid, **30 by 36 inches**.
- C. Loads: Minimum **40-lbf/sq. ft.** external live load and **20-lbf/sq. ft.** internal uplift load.
- D. Hatch Material: Aluminum-zinc alloy-coated steel sheet.
 - 1. Thickness: Manufacturer's standard thickness for hatch size indicated.
 - 2. Finish: Two-coat fluoropolymer or Baked enamel or powder coat.

3. Color: As selected by Architect from manufacturer's full range.
- E. Hatch Material: Aluminum sheet.
1. Thickness: Manufacturer's standard thickness for hatch size indicated.
 2. Finish: Two-coat fluoropolymer or Baked enamel or powder coat.
 3. Color: As selected by Architect from manufacturer's full range.
- F. Construction:
1. Insulation: **1-inch- (25-mm-)** thick, glass-fiber board
 - a. R-Value: 4.3 according to ASTM C1363.
 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
 3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 4. Fabricate curbs to minimum height of **12 inches (305 mm)** above roofing surface unless otherwise indicated.
- G. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 2. Height: **42 inches (1060 mm)** above finished roof deck.
 3. Material: Steel tube.
 4. Post: **1-5/8-inch- (41-mm-)** diameter pipe.
 5. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: As selected by Architect from manufacturer's full range.

2.3 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, **G90 (Z275)** coating designation.
1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.

2. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils (0.05 mm)**.
 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, **AZ50 (AZM150)** coated.
1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
 2. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils (0.05 mm)**.
 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- C. Aluminum Sheet: **ASTM B209 (ASTM B209M)**, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
1. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 2. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
 3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- D. Aluminum Extrusions and Tubes: **ASTM B221 (ASTM B221M)**, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- E. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.
- F. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

- G. Steel Tube: ASTM A500/A500M, round tube.
- H. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
- I. Steel Pipe: ASTM A53/A53M, galvanized.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), thickness as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, [**containing no arsenic or chromium,**] and complying with AWWA C2; not less than 1-1/2 inches (38 mm) thick.
- D. Underlayment:
 - 1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 - 2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D4397.
 - 3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
 - 4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
- F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- G. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- H. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- I. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

- C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."

- C. Clean exposed surfaces according to manufacturer's written instructions.

- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

1.2 ACTION SUBMITTALS

A. Product data.

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 developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

1.3 INFORMATIONAL SUBMITTALS

A. Listed system designs.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

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 in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.
 - 1) UL in its online directory "Product iQ."
 - 2) Intertek Group in its "Directory of Building Products."
 - 3) FM Approvals in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Description: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems are to be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. 3M
2. Balco
3. STI

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of the floor. The following floor penetrations do not require a T-rating:
 - a. Those within the cavity of a wall.
 - b. Floor, tub, or shower drains within a concealed space.

- c. **4-inch (200-mm)** or smaller metal conduit penetrating directly into metal-enclosed electrical switchgear.
 3. W-Rating: Provide penetration firestopping systems with a Class 1 W-rating in accordance with UL 1479.
 4. L-Rating: Not exceeding **5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m)** of penetration opening and no more than **50-cfm (0.024-cu. m/s)** cumulative total for any **100 sq. ft. (9.3 sq. m)** at both ambient and elevated temperatures.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, in accordance with ASTM E84.
- 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 OF PENETRATION FIRESTOPPING SYSTEMS

- 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. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than **3 inches (76 mm)** high and with minimum **0.375-inch (9.5-mm)** strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at **15 feet (4.57 m)** from end of wall and at intervals not exceeding **30 feet (9.14 m)**.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches (150 mm)** 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 E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated construction.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines.

1.3 INFORMATIONAL SUBMITTALS

A. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with Listed System Designs published by a qualified testing agency.
 - 1) UL in its online directory "Product iQ."
 - 2) Intertek Group in its "Directory of Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
 1. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
 2. Provide firestop products that do not contain ethylene glycol.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

2.3 ACCESSORIES

- A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- D. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric 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. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than **3 inches (76 mm)** high and with minimum **0.375-inch (9.5-mm)** strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at **15 ft. (4.57 m)** from end of wall and at intervals not exceeding **30 ft. (9.14 m)**.
- B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches (150 mm)** of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. 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 - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing 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 in accordance with ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonstaining silicone joint sealants.
 - 2. Latex joint sealants.

1.2 ACTION SUBMITTALS

- A. Product data.
- B. Samples: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-sealant schedule.

1.3 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.
- B. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty Documentation:
 - 1. Manufacturers' special warranties.
 - 2. Installer's special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants 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.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Dow Corning
 - 2. Sika
 - 3. Pecora

2.3 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Sherwin Williams
 - 2. PPG
 - 3. Pecora

2.4 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, 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.

2.5 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 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.

- B. **Joint Priming:** Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. 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 or primer 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.

3.2 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 C1193 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 in accordance with requirements specified in subparagraphs 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 profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. 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.
- H. 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 Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 080314 - HISTORIC TREATMENT OF WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Historic treatment of wood doors in the form of the following:
 - a. Repairing wood doors and trim.
 - b. Reglazing.
 - c. Repairing, refinishing, and replacing hardware.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

- A. Door: Generally, this term includes door frame, leaves, hardware, side panels or lights, fan light, transom, storm and screen doors, and storm vestibule unless otherwise indicated by context.
- B. Glazing: Includes glass, glazing points, glazing tapes, glazing sealants, and glazing compounds.
- C. Wood Door Component Terminology: Wood door components for historic treatment work include the following classifications:
1. Frame Components: Head, jambs, stop, and threshold or sill.
 2. Leaf Components: Stiles, rails, and muntins.
 3. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.
 4. Interior Trim: Casing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of wood doors.
2. Review methods and procedures related to historic treatment of wood doors.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

- B. Shop Drawings: Include plans, elevations, sections, and details of replacement parts indicating materials, profiles, joinery, reinforcing, method of splicing into or attaching to existing wood door, accessory items, and finishes.

1.5 QUALITY ASSURANCE

- A. Historic Treatment Specialist Qualifications: A qualified historic wood door specialist, experienced in repairing, refinishing, and replacing wood doors in whole and in part. Experience only in fabricating and installing new wood doors is insufficient experience for wood-door historic treatment work.
- B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing **wood** consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

1.6 MOCKUPS

- A. Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation. Prepare mockups so they are inconspicuous.
 - 1. Wood Door Repair: Prepare one entire door unit to serve as mockup to demonstrate Samples of each type of repair of wood door members including frame, leaves, trim, glazing, and hardware.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD DOORS QUALITY STANDARD

- A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWMAC/WI's "North American Architectural Woodwork Standards" for construction, finishes, grades of wood doors, and other requirements unless otherwise indicated.
 - 1. Exception: Industry practices cited in Section 12, Paragraph 6, "Industry Practices," under Article 12.1, "Basic Considerations," of AWMAC/WI's "North American Architectural Woodwork Standards" do not apply to the Work of this Section.

2.2 WOOD-REPLACEMENT MATERIALS

- A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than **1/32 inch (0.8 mm)** deep by **2 inches (51 mm)** wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

2.3 WOOD-REPAIR MATERIALS

- A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated because of weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.
- B. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound to be designed for filling voids in damaged wood materials that have deteriorated because of weathering and decay. Compound to be capable of filling deep holes and spreading to feather edge.

2.4 HARDWARE

- A. Primary Door Hardware, General: Provide complete sets of door hardware consisting of hinges, pulls, locks, latches, and accessories indicated for each door or required for proper operation. Sets to include replacement hardware to complement repaired and refinished, existing hardware. Door hardware to smoothly operate, tightly close, and securely lock wood doors and be sized to accommodate frequency of use, glazing weight, and dimensions.
- B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.
- C. Material and Design:
 1. Material: Solid bronze of alloy indicated unless otherwise indicated.
 2. Design: Match type and appearance of existing hardware.
- D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.5 WOOD DOOR FINISHES

- A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.
- B. Factory-Primed Replacement Units: Manufacturer's standard factory-prime coat on exposed exterior and interior wood surfaces; compatible with indicated finish coating.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean wood doors and trim of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
- B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT OF WOOD DOORS, GENERAL

- A. General: In treating historic items, disturb them as minimally as possible and as follows:
 - 1. Stabilize and repair wood doors to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
 - 2. Remove coatings and apply borate preservative treatment before repair. Remove coatings in accordance with Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
 - 3. Repair items in place where possible.
 - 4. Install temporary protective measures to protect wood door work that is indicated to be completed later.
 - 5. Refinish historic wood doors in accordance with Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
- B. Mechanical Abrasion: Where mechanical abrasion is needed for the Work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as approved by Architect.
- C. Repair and Refinish Existing Hardware: Dismantle door hardware; strip paint, repair, and refinish it to match finish Samples; and lubricate moving parts just enough to function smoothly.
- D. Repair Wood Doors: Match existing materials and features, retaining as much original material as possible to perform repairs.
 - 1. Unless otherwise indicated, repair wood doors by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
 - 2. Where indicated, repair wood doors by limited replacement matching existing material.
- E. Replace Wood Units: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

- F. Protection of Openings: Where doors are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.
- G. Identify removed doors, frames, leaves, trim, and members with numbering system corresponding to door locations to ensure reinstallation in same location.

3.3 WOOD DOOR PATCH-TYPE REPAIR

- A. General: Patch wood members that exhibit depressions, holes, or similar voids and that have limited amounts of rotted or decayed wood.
 - 1. Treat wood members with wood consolidant before applying patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and unable to absorb more. Allow treatment to harden before filling void with patching compound.
 - 2. Remove rotted or decayed wood down to sound wood.
- B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.
- C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.
 - 1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
 - 2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
 - 3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD DOOR MEMBER-REPLACEMENT REPAIR

- A. General: Replace parts of or entire wood door members at locations indicated on Drawings and where damage is too extensive to patch.
 - 1. Remove broken, rotted, and decayed wood down to sound wood.
 - 2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
 - 3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.
- B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
- C. Repair remaining depressions, holes, or similar voids with patch-type repairs.
- D. Clean spilled materials from adjacent surfaces immediately.

- E. Glazing: Reglaze units before reinstallation.
 - 1. Mill new and rout existing glazed members to accommodate new glass thickness.
 - 2. Provide replacement glazing stops coordinated with glazing system indicated.
 - 3. Provide glazing stops to match contour of door frames.
- F. Reinstall units removed for repair into original openings.
- G. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter weather stripping for each exterior leaf.

3.5 GLAZING

- A. Comply with combined written instructions of glass, glazing system, and glazing material manufacturers, unless more stringent requirements are indicated.
- B. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing.
- C. Size glass as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.
- D. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.
- E. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.
- F. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.
- G. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.6 WOOD DOOR UNIT REPLACEMENT

- A. General: Replace existing wood door-frame, leaf, and trim units with new custom-fabricated replicated units at locations where damage is too extensive to repair.
- B. Apply borate preservative treatment to accessible surfaces before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
- C. Mill glazed members to accommodate glass thickness. Glaze units before installation.
- D. Install units level, plumb, square, true to line, without distortion or impeding movement, anchored securely in place to structural support, and in proper relation to wall flashing, trim, and other adjacent construction.

- E. Set threshold or sill members in bed of sealant for weathertight construction unless otherwise indicated.
- F. Install door units with new anchors into existing openings.
- G. Install full-perimeter weather stripping for each operable exterior leaf.
- H. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- I. Disposal of Removed Units: Remove from Owner's property and legally dispose of them unless otherwise indicated.

END OF SECTION 080314

SECTION 080352 - HISTORIC TREATMENT OF WOOD WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes historic treatment of wood windows in the form of the following:
 - 1. Repairing wood windows and trim.
 - 2. Replacing wood window frames and sash units.
 - 3. Reglazing.
 - 4. Repairing, refinishing, and replacing hardware.
- B. Related Requirements:
 - 1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

- A. Window: Includes window frame, sash, hardware, trim, storm window, and exterior and interior shutters unless otherwise indicated by context.
- B. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.
- C. Interior Trim: Casing, stool, and apron.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of wood windows and fire protection.
 - 2. Review methods and procedures related to historic treatment of wood windows.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, and sections showing locations and details of each new unit and its corresponding window locations in the building on annotated plans and elevations.

1.5 QUALITY ASSURANCE

- A. Historic Treatment Specialist Qualifications: A qualified historic wood window specialist, experienced in repairing, refinishing, and replacing wood windows in whole and in part. Experience only in fabricating and installing new wood windows is insufficient experience for wood-window historic treatment work.
- B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD WINDOWS, GENERAL

- A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grades of wood windows, and other requirements unless otherwise indicated.
 - 1. Exception: Industry practices cited in Section 12, Article 1.5, Industry Practices, of the Architectural Woodwork Standards do not apply to the work of this Section.

2.2 REPLICATED WOOD WINDOW UNITS

- A. Replicated Wood Window Frames and Sash: Custom-fabricated replacement wood units and trim, with operating and latching hardware.
 - 1. Wood Species: Match wood species of exterior window trim and sash parts.
 - 2. Wood Window Members and Trim: Match profiles and detail of existing window members and trim.
 - 3. Glazing Stops: Provide replacement glazing stops coordinated with glazing system indicated.
 - 4. Integral, Storm and Screen Sash Inserts: Manufacturer's standard framed sash inserts; sash-insert frames recessed fully in rebates routed in window frame or sash as required; and secured with turn-button hardware. Provide insect screen for each operable exterior sash or ventilator. Shop finish sash inserts to match window frame.
 - 5. Exposed Hardware: Reuse or Match if not possible to reuse, existing exposed window hardware.
 - 6. Weather Stripping: Full-perimeter and meeting rail weather stripping for each operable sash.

2.3 WOOD-REPAIR MATERIALS

- A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.
- B. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

2.4 GLAZING MATERIALS

- A. Glazing Systems:
 - 1. Modern Glazing Products: Glazing points and single-component polyurethane glazing compound; struck to match taper of existing glazing putty (removed); colored as required to match painted sash.
 - 2. Primers and Cleaners for Glazing: As recommended in writing by glazing material manufacturer.

2.5 HARDWARE

- A. Window Hardware: Provide complete sets of window hardware consisting of sash balances, hinges, pulls, latches, and accessories indicated for each window or required for proper operation. Sets shall include replacement hardware to complement repaired and refinished, existing hardware. Window hardware shall smoothly operate, tightly close, and securely lock wood windows and be sized to accommodate sash or ventilator weight and dimensions.
- B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware.
- C. Material and Design:
 - 1. Material: Solid bronze of alloy indicated unless otherwise indicated.
 - 2. Design: Match type and appearance of existing hardware.
 - 3. Weight and Pulley Sash-Balance: Concealed weight and pulley balance system including steel or cast iron weights, cast-bronze pulleys, synthetic sash cord or sash chain; size and capacity to hold sash stationary at any open position.
 - 4. Spring Sash-Balance: Concealed type; size and capacity to hold sash stationary at any open position.
- D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated.

2.6 WEATHER STRIPPING

- A. Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when window is closed.
 - 1. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.
 - a. Cellular Elastomeric Gaskets: Preformed; complying with ASTM C509.
 - b. Dense Elastomeric Gaskets: Preformed; complying with ASTM C864.
- B. Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric.
 - 1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material.
- C. Metal Weather Stripping: Bronze weather stripping; designed either as one piece to seal by sliding into a groove in the sash or as two pieces that interlock; and completely concealed when window is closed.

2.7 MISCELLANEOUS MATERIALS

- A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; complying with AWWA P5; containing no boric acid.
- B. Cleaning Materials:
 - 1. Detergent Solution: Solution prepared by mixing **2 cups (0.5 L)** of tetrasodium pyrophosphate (TSPP), **1/2 cup (125 mL)** of laundry detergent that contains no ammonia, **5 quarts (5 L)** of 5 percent sodium hypochlorite bleach, and **15 quarts (15 L)** of warm water for each **5 gal. (20 L)** of solution required.
 - 2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing **1/3 cup (80 mL)** of household detergent that contains no ammonia, **1 quart (1 L)** of 5 percent sodium hypochlorite bleach, and **3 quarts (3 L)** of warm water.
- C. Adhesives: Wood adhesives for exterior exposure, with minimum 15- to 45-minute cure at **70 deg F (21 deg C)**, in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair.
- D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.
 - 1. Match existing fasteners in material and type of fastener unless otherwise indicated.
 - 2. Use concealed fasteners for interconnecting wood components.
 - 3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.

4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
 5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
 6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.
- E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

2.8 WOOD WINDOW FINISHES

- A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.
- B. Factory-Primed Replacement Units: Manufacturer's standard factory-prime coat on exposed exterior and interior wood surfaces; compatible with indicated finish coating.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean wood windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
- B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT OF WOOD WINDOWS, GENERAL

- A. General: In treating historic items, disturb them as minimally as possible and as follows:
 1. Stabilize and repair wood windows to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
 2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
 3. Repair items in place where possible.
 4. Install temporary protective measures to protect wood window work that is indicated to be completed later.
 5. Refinish historic wood windows according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

- B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as approved by Architect.
- C. Repair and Refinish Existing Hardware: Dismantle window hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.
- D. Repair Wood Windows: Match existing materials and features, retaining as much original material as possible to perform repairs.
 - 1. Unless otherwise indicated, repair wood windows by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
 - 2. Where indicated, repair wood windows by limited replacement matching existing material.
 - 3. Sash Balance: Repair sash balances to function according to type as specified in "Hardware" Article" above. Provide missing sash balances.
- E. Replace Wood Units: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.
- F. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.
- G. Identify removed windows, frames, sash, and members with numbering system corresponding to window locations to ensure reinstallation in same location.

3.3 WOOD WINDOW PATCH-TYPE REPAIR

- A. General: Patch wood members that exhibit depressions, holes, or similar voids, and that have limited amounts of rotted or decayed wood.
 - 1. Treat wood members with wood consolidant before applying patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and unable to absorb more. Allow treatment to harden before filling void with patching compound.
 - 2. Remove rotted or decayed wood down to sound wood where patching not feasible.
- B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood.
- C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.
 - 1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
 - 2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.

3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.

3.4 WOOD WINDOW MEMBER-REPLACEMENT REPAIR

- A. General: Replace parts of or entire wood window members at locations where damage is too extensive to patch.
 1. Remove broken, rotted, and decayed wood down to sound wood.
 2. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
 3. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.
- B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
- C. Repair remaining depressions, holes, or similar voids with patch-type repairs.
- D. Glazing: Reglaze units before reinstallation.
 1. Mill new and rout existing glazed members to accommodate new glass thickness.
 2. Provide replacement glazing stops coordinated with glazing system indicated.
 3. Provide glazing stops to match contour of sash frames.
- E. Reinstall units removed for repair into original openings.
- F. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter and meeting rail weather stripping for each operable sash.

3.5 GLAZING

- A. Comply with combined written instructions of manufacturers of glass, glazing systems, and glazing materials, unless more stringent requirements are indicated.
- B. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing..
- C. Size glass as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.
- D. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.
- E. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

- F. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.
- G. Disposal of Removed Glass: Remove from Owner's property and legally dispose of it unless otherwise indicated.

3.6 WOOD WINDOW UNIT REPLACEMENT

- A. General: Replace existing wood units with new custom-fabricated units to match existing at locations where damage is too extensive to repair.
- B. Apply borate preservative treatment to accessible surfaces before finishing. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.
- C. Mill glazed members to accommodate glass thickness. Glaze units before installation.
- D. Install units level, plumb, square, true to line, without distortion or impeding movement; anchored securely in place to structural support; and in proper relation to wall flashing, trim, and other adjacent construction.
- E. Set sill members in bed of sealant for weathertight construction unless otherwise indicated.
- F. Install window units with new anchors into existing openings.
- G. Weather Stripping: Install full-perimeter and meeting rail weather stripping for each operable sash.
- H. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- I. Disposal of Removed Units: Remove from Owner's property and legally dispose of them unless otherwise indicated.

3.7 WEATHER STRIPPING INSTALLATION

- A. Install weather stripping for tight seal of joints as determined by preconstruction testing and demonstrated in mockup.

END OF SECTION 080352

SECTION 081433 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Interior stile and rail wood doors.
 2. Interior fire-rated stile and rail wood doors.
 3. Fire-rated wood door frames.
 4. Factory fitting stile and rail wood doors to frames and factory machining for hardware.
 5. Factory finishing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
1. Details of construction and glazing.
 2. Door frame construction.
 3. Factory-machining criteria.
 4. Factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:
1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
 2. Door elevations, dimensions and location of hardware, lite locations, and glazing thickness.
 3. Details of frame for each frame type, including dimensions and profile.
 4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 5. Clearances and undercuts.
 6. Requirements for veneer matching.
 7. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples: For factory-finished doors and factory-finished door frames.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.

2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality control reports.

1.4 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies must meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies must meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.2 MATERIALS

- A. Use only materials that comply with referenced standards and other requirements specified.
 - 1. Assemble exterior doors, including components, with wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.
 - 2. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.
- B. Panel Products: Any of the following unless otherwise indicated:
 - 1. Particleboard: ANSI A208.1, Grade M-2.
 - 2. Medium-density fiberboard (MDF), complying with ANSI A208.2, Grade 130.
 - 3. Hardboard complying with ANSI A135.4.
 - 4. Veneer-core plywood.
- C. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.

2.3 INTERIOR STILE AND RAIL WOOD DOORS

- A. Interior Stile and Rail Wood Doors: Interior custom doors complying with WDMA I.S. 6A and with other requirements specified.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Masonite Architectural
 - b. VT Industries
 - c. TruStile
 - 2. Performance Grade:
 - a. WDMA I.S. 6A: Custom.
 - 3. Finish: Transparent.
 - 4. Wood Species and Cut for Transparent Finish: Red oak, quarter sawed/sliced stiles and rails, plain sawed/sliced panels.
 - 5. Stile and Rail Widths: Match salvaged door panels looking to replicate.
 - 6. Flat-Panel Thickness: 3/8 inch (10 mm).
 - 7. Molding Profile (Sticking): Match salvaged doors looking to replicate. See drawings.
 - 8. Glass: Uncoated, clear, fully tempered float glass, 5.0 mm thick, complying with Section 088000 "Glazing."
 - 9. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.4 INTERIOR FIRE-RATED STILE AND RAIL WOOD DOORS

- A. 45-Minute, Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated (45-minute rating) doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Masonite Architectural.
 - b. VT Industries.
 - c. TruStile.
 2. Performance Grade:
 - a. WDMA I.S. 6A: Custom.
 3. Finish: Transparent.
 4. Wood Species and Cut for Transparent Finish: Red oak, quarter sawed/sliced stiles and rails, plain sawed/sliced panels.
 5. Interior Fire-Rated Door Construction: 1-3/4-inch- (44-mm-) thick, edged and veneered mineral-core stiles and rails and 1-1/8-inch- (29-mm-) thick, veneered mineral-core raised panels.
 6. Edge Construction for Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - a. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: in accordance with WDMA T.M. 10.
 7. Edge Construction for Fire-Rated Pairs of Doors:
 - a. Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - 1) At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 8. Stile and Rail Widths: Match salvaged door panels looking to replicate.
 - a. Stiles, Top and Intermediate Rails: Match salvaged door panels looking to replicate. See drawings.
 - b. Bottom Rails: Match salvaged door panels looking to replicate. See drawings.
 - c. Molding Profile (Sticking): Match salvaged doors looking to replicate. See drawings.

2.5 FIRE-RATED WOOD DOOR FRAMES

- A. Interior Frames:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Masonite Architectural.
 - b. VT Industries.
 - c. TruStile.
2. WDMA I.S. 6A Grade: Custom.
3. Wood Species and Cut: Match species and cut indicated for wood doors unless otherwise indicated.
4. Species: Red oak.
5. Cut: Plain sliced/plain sawn.
6. Wood Moisture Content: 5 to 10 percent.
7. Profile: Double rabbet.
8. Construction: Solid lumber, fire-retardant particleboard, or fire-retardant medium density fiberboard (MDF) with veneered exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated on Drawings.

2.6 STILE AND RAIL WOOD DOOR FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:
 1. Clearances:
 - a. Provide 1/8 inch (3 mm) at heads, jambs, and between pairs of doors.
 - b. Provide 1/2 inch (13 mm) from bottom of door to top of decorative floor finish or covering.
 - c. Where threshold is shown on Drawings or scheduled, provide not more than 3/8 inch (10 mm) from bottom of door to top of threshold.
 - d. Comply with NFPA 80 requirements for fire-rated doors.
 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) on lock edge; trim stiles and rails only to extent permitted by labeling agency.
- B. Factory machine doors for hardware that is not surface applied.
 1. Locate hardware to comply with DHI-WDHS-3.
 2. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 3. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 4. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Glazed Openings:
 1. Factory install glazing in doors, complying with Section 088000 "Glazing." Install glass using manufacturer's standard elastomeric glazing sealant complying with ASTM C920.

Secure glass in place with removable wood moldings. Miter wood moldings at corner joints.

2.7 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 - 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 2. Finish faces, all four edges, edges of cutouts, and mortises.
 - 3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
 - a. Architectural Woodwork Standards System 5, varnish, conversion.
 - 2. Staining: Match Architect's sample.
 - 3. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
 - 4. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated door frames in accordance with NFPA 80.
 - a. Install frames level, plumb, true, and straight.
 - 1) Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
 - b. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - 1) Secure with countersunk, concealed fasteners and blind nailing.
 - 2) Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - c.
 - d. For shop-finished items, use filler matching finish of items being installed.

2. Install fire-rated doors in accordance with NFPA 80.
3. Install smoke- and draft-control doors in accordance with NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory- Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.2 FIELD QUALITY CONTROL

A. Inspections:

1. Provide inspection of installed Work through AWI's Quality Certification Program, certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door installations comply with specified requirements.

D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081433

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

1.3 ADDITIONAL

- A. Provide (4) additional access doors, for wall locations, in addition to the quantity noted on the plans. These are to be installed where directed in the field by the Owner's Representative.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches (150 by 150 mm) in size.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Recessed Access Doors:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, product specified is **Recessed DW-5015 Access Door as manufactured by Acudor Products Inc.** or comparable product.

2. Description: 22 gauge galvanized steel door and frame with concealed hinge.
3. Locations: Ceilings.
4. Door Size: 12" x 12" (4) and 18" x 18" (2). Locations to be determined.
5. Frame Material: Same material and thickness as door.
6. Latch and Lock: Cylinder lock and key. Provide cam lock C-415A keyed alike.

B. Recessed Access Doors with Exposed Flanges:

1. Basis-of-Design Product: Subject to compliance with requirements, product specified is **Universal Flush UF-5500 Standard Access Door** as manufactured by Acudor Products Inc. or comparable product.
2. Description: 20 gauge galvanized steel door and frame with concealed hinge.
3. Locations: Walls
4. Door Size: 12" x 12" (4 – locations to be determined).
5. Frame Material: Same material and thickness as door.
6. Latch and Lock: Cylinder lock and key. Provide cam lock C-415A keyed alike.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- C. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.

1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.

2.5 FINISHES

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Factory Primer: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning, with min. dry-film thickness of 1 mil for topcoat.
 2. Paint to match adjacent ceiling color.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

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. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

- C. Samples: For each type of exposed finish required.

- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.4 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

- B. Product test reports.

- C. Source quality-control reports.

- D. Field quality-control reports.

- E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Qualifications:

1. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. 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.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts 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 window and hardware.
- d. Deterioration of materials and finishes beyond normal weathering.
- e. Failure of insulating glass.

2. Warranty Period:

- a. Glazing Units: 10 years from date of Substantial Completion.
- b. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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, 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.
- B. Structural Loads:
1. Wind Loads: As indicated on Drawings.
- C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span in the amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
 3. Cantilever Deflection: Limited to 2L/175 at unsupported cantilevers.
- D. Structural: Test in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
- E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

F. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.33 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 - b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F (3.86 W/sq. m x K) as determined in accordance with NFRC 100.
2. Solar Heat-Gain Coefficient (SHGC):
 - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.40 as determined in accordance with NFRC 200.
 - b. Entrance Doors: SHGC of not more than 0.40 as determined in accordance with NFRC 200.
3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with ASTM E283.
 - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STOREFRONT SYSTEMS

A. Manufacturers:

1. Basis of Design – Kawneer Trifab VersaGlaze 451T or comparable product by one of the following:
 - a. EFCO Corporation
 - b. Peerless Products, Inc.
 - c. TRACO
 - d. Wausau Window and Wall Systems

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.

2. Interior Vestibule Framing Construction: Nonthermal.
 3. Glazing System: Retained mechanically with gaskets on four sides.
 4. Finish: Clear anodic finish.
 5. Fabrication Method: Field-fabricated stick system.
 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 7. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 ENTRANCE DOOR SYSTEMS

- A. Manufacturers:
1. Basis of Design – Kawneer 350 Standard Entrances or comparable product by one of the following:
 - a. EFCO Corporation
 - b. Peerless Products, Inc.
 - c. TRACO
 - d. Wausau Window and Wall Systems
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Pivot Hinges: BHMA A156.4, Grade 1.
1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.
- E. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
 2. Exterior Hinges: Stainless steel, with stainless steel pin.
 3. Quantities:
 - a. For doors up to 87 inches (2210 mm) high, provide three hinges per leaf.
 - b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm) high, provide four hinges per leaf.
- F. Continuous-Gear Hinges: BHMA A156.26.
- G. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- H. Manual Flush Bolts: BHMA A156.16, Grade 1.
- I. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- J. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.

K. Cylinders:

1. As specified in Section 087100 "Door Hardware."
2. BHMA A156.5, Grade 1.
 - a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".

L. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

M. Operating Trim: BHMA A156.6.

N. Removable Mullions: BHMA A156.3 extruded aluminum.

1. When used with panic exit devices, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305. Use only mullions that have been tested with exit devices to be used.

O. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

P. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.

Q. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

R. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

S. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

T. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

U. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.5 GLAZING

A. Glazing: Comply with Section 088000 "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. Glazing Sealants: As recommended by manufacturer.

2.6 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
 - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: 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 in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. 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. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

3.3 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

- A. Install entrance 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.
 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
 2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - a. Perform a minimum of two tests in areas as directed by Architect.
 3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
 4. Egress Door Inspections: Inspect each aluminum-framed entrance door equipped with panic hardware, each aluminum-framed entrance door located in an exit enclosure, each electrically controlled aluminum-framed egress door, and each aluminum-framed entrance door equipped with special locking arrangements, in accordance with NFPA 101, Section 7.2.1.15.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

LaBella Associates, D.P.C.
Project No. 2221723

Academic Innovation Hub
Work Force Development Training
Niagara University

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END OF SECTION 084113

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum protection windows for exterior side of existing Sanctuary stained glass window locations.
- B. Related Requirements:
 - 1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 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 and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
 - 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
 - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
 - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
 - 1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

- D. Samples for Initial Selection: For units with factory-applied finishes.
 - 1. Include Samples of hardware and accessories involving color selection.
- E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
 - 1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
 - 2. Exposed Hardware: Full-size units.
- F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.4 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 quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.5 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 installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:

- a. Window: 2 years from date of fabrication.
- b. Aluminum Finish: 5 years from date of Installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 1. Minimum Performance Class: CW.
 2. Minimum Performance Grade: 30.
- C. 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 (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.

2.3 ALUMINUM WINDOWS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Sussman Architectural Products LLC, 200X Series (**Basis of Design**).
 2. Glass Heritage LLC.
- B. Types: Provide the following types in locations indicated on Drawings:
 1. Fixed.
- C. Materials:
 1. Extruded aluminum shall be 6063-T5 alloy and temper with a minimum ultimate tensile strength of 22,000 psi. Comply with ASTM B 221.

2. Fasteners shall be aluminum, stainless steel or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors and other components of the window units.

D. Acrylic Glazing: See Glazing Schedule on drawings.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.4 FABRICATION

A. General

1. All main sections shall have a minimum depth of 1 5/8" with a nominal wall thickness of .125 to .080.
2. Glazing rebates shall not be less than 5/8" in height.
3. Window members must incorporate the glazing legs as an integral part of the frame, sash, and muntin bar design. Mechanically applied glazing legs will not be accepted.
4. All joints shall be cut to a hairline fit and be either fully sigma arc welded or shall be heavy angle reinforced, cold welded with epoxy adhesive and hydraulically crimped.
5. All joints shall be factory sealed.

B. Ventilation

1. Provide aluminum extrusions designed specifically for venting purposes.
2. Drill vent holes into extruded window members to provide adequate ventilation.
3. Insert a dust and insect screen over the holes within the window member.
4. On the exterior of the window member, install a nylon vent hole cover to hide the vent holes and prevent water infiltration.
5. Manufacturer to determine required amount of vent holes needed per stain glass window location for proper ventilation between the stain glass window and the protection window glass.

C. Glazing Beads

1. Glazing beads shall be extruded from 6063-T5 alloy and be not less than .050 thick.
2. The glazing beads will be snap in type to securely interlock into the extruded window members without extending underneath the glass.
3. They shall be factory fitted and attached.
4. Glazing beads shall also be secured with stainless steel fasteners where required.

D. Weatherstripping

1. Each sash shall have 2 continuous rows of tested Schlegel Q-Lon weatherstripping installed in specially designed dovetail grooves.
2. Weatherstripping shall have a rigid backing that will resist pullout. A single durometer vinyl or rubber weatherstripping will not be accepted.

E. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

F. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

- G. 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. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.5 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: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermos-cured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with 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 E2112.
- 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.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 - 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
 - 2. Air-Infiltration Testing:
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: **1.5** times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
 - 3. Water-Resistance Testing:
 - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
 - b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
 5. Test Reports: Prepared according to AAMA 502.
- C. Windows will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- 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. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 085200 – ALUMINUM CLAD WOOD WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum-clad windows.

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. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.
 - c. Aluminum-Cladding Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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: WDMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: CW.
 - 2. Minimum Performance Grade: 40.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.26 Btu/sq. ft. x h x deg F.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of **0.29**.

2.2 WOOD WINDOWS

- A. Aluminum-Clad Wood Windows:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **Marvin Windows and Doors** Historic Replacement Windows or a comparable product by one of the following:
 - 1. Weather Shield Mfg., Inc.
 - 2. Andersen Windows, Inc. ; Andersen Corporation.
- C. Operating Types: Double Hung.
- D. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.
 - 1. Exterior Finish: Aluminum-clad wood.
 - a. Aluminum Finish: Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight and complying with AAMA 2605.
 - 2. Interior Finish: Manufacturer's standard color-coated finish.
- E. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.
 - a. Tint: Clear.
 - b. Kind: Fully tempered.
 2. Lites: Two.
 3. Filling: Fill space between glass lites with argon.
 4. Low-E Coating: Sputtered on third surface.
- F. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- G. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- H. Hung Window Hardware:
1. Counterbalancing Mechanism: AAMA 902.
 2. Locks and Latches: Operated from the inside only.
 3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis.
- I. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- J. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- 2.3 INSECT SCREENS
- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
1. Type and Location: Half, outside for single-hung sashes.
- B. Aluminum Frames: Complying with SMA 1004 or SMA 1201.
1. Finish for Exterior Screens: Matching color and finish of cladding.
- C. Glass-Fiber Mesh Fabric: 18-by-14 (1.1-by-1.4-mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D3656/D3656M.
1. Mesh Color: Manufacturer's standard.

2.4 FABRICATION

- A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.
- B. Glaze wood windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. 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. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with 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 E2112.
- B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- D. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
- E. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085200

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Continuous, gear-type hinges.
3. Bored locks.
4. Mortise locks.
5. Electric strikes.
6. Manual flush bolts.
7. Exit devices and auxiliary items.
8. Lock cylinders.
9. Operating trim.
10. Coordinators.
11. Carry-open bars.
12. Surface closers.
13. Concealed closers.
14. Closer holder release devices.
15. Wall- and floor-mounted stops.
16. Overhead stops and holders.
17. Door gasketing.
18. Thresholds.
19. Metal protective trim units.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Keying Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product data.
- B. Shop Drawings: For electrified door hardware.
 1. Diagrams for power, signal, and control wiring.
 2. Details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified.

D. Door hardware schedule.

E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. **Installer Qualifications:** Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. **Scheduling Responsibility:** Preparation of door hardware and keying schedule.
2. **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. **Architectural 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 an Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC).

1.7 WARRANTY

A. **Special Warranty:** Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. **Warranty Period:** Three years from date of Substantial Completion unless otherwise indicated below:
 - a. **Exit Devices:** Two years from date of Substantial Completion.
 - b. **Manual Closers:** 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 1. Air-Leakage Rate: Maximum air leakage of 0.3 cfm per sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3 inch wg (75 Pa) of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC A117.1.

2.2 HINGES

- A. Hinges: ANSI/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. Allegion plc.
 - b. Hager Companies.
 - c. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.3 CONTINUOUS HINGES

- A. Continuous, Gear-Type Hinges: ANSI/BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings. Minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Allegion plc.
- b. Hager Companies.
- c. Stanley Commercial Hardware; a division of Stanley Security Solutions.

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. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
 3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.
- D. Lock Trim:
 1. Description: As indicated on Drawings.
 2. Levers: Cast.
 3. Escutcheons (Roses): Wrought.
 4. Dummy Trim: Match lever lock trim and 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. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- F. Bored Locks: ANSI/BHMA A156.2, Grade 2, Series 4000.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. SARGENT Manufacturing Company; ASSA ABLOY.
 - c. Stanley Commercial Hardware; a division of Stanley Security Solutions.
- G. Mortise Locks: ANSI/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. Allegion plc.
- b. SARGENT Manufacturing Company; ASSA ABLOY.
- c. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.5 ELECTRIC STRIKES

- A. Electric Strikes: ANSI/BHMA A156.31, Grade 1; with faceplate to suit lock and frame.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager
 - b. Adams Rite
 - c. HES

2.6 MANUAL FLUSH BOLTS

Manual flush bolts are for inactive leaf of a pair of doors. They are available for labeled fire-rated doors but do not meet model code requirements for doors used as a means of egress.

- A. Manual Flush Bolts: ANSI/BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager
 - b. Rockwood
 - c. Trimco

2.7 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: ANSI/BHMA A156.3.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager
 - b. Von Duprin
 - c. Sargent

2.8 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

- B. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.
 - 1. Core Type: Interchangeable.
- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

2.9 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock.
 - 1. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders. Coordinate final key system and keying with Owner.
 - a. Provide three cylinder change keys and five each of master and grand master keys.
 - 2. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - 3. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: Information to be furnished by Owner.

2.10 OPERATING TRIM

- A. Operating Trim: ANSI/BHMA A156.6; aluminum or stainless steel unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products as indicated on Hardware Schedule.

2.11 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: ANSI/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; and with internal override.
- B. Carry-Open Bars: ANSI/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.

- C. Astragals: ANSI/BHMA A156.22.

2.12 SURFACE CLOSERS

- A. Surface Closers: ANSI/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 instructions 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:
 - a. Allegion plc.
 - b. DORMA USA, Inc.
 - c. Hager Companies

2.13 .CONCEALED CLOSERS

- A. Concealed Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions 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:
 - a. Allegion plc.
 - b. DORMA USA, Inc.

2.14 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: ANSI/BHMA A156.8.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Glynn Johnson
 - c. Sargent

2.15 DOOR GASKETING

- A. Door Gasketing: ANSI/BHMA A156.22; 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. Hager Companies.
- b. Pemko Manufacturing Co.

B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg (75 Pa), as follows:

- 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
- 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
- 3. Gasketing on Double Doors: 0.50 cfm per ft. (0.000774 cu. m/s per m) of door opening.

2.16 THRESHOLDS

A. Thresholds: ANSI/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. Hager Companies.
- b. Pemko Manufacturing Co.
- c. Rixson Specialty Door Controls; an ASSA ABLOY Group company.

2.17 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) 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. Allegion plc.
- b. Hager Companies.
- c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.18 AUXILIARY DOOR HARDWARE

A. Auxiliary Door Hardware: ANSI/BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Allegion plc.
- b. Hager Companies.
- c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.19 FINISHES

- A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 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's "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.
- 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 (760 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (760 mm) of door height greater than 90 inches (2286 mm).
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, **above** accessible ceilings or 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 floor stops for doors unless wall 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, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- 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.

3.2 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.

3.3 DOOR HARDWARE SCHEDULE

- A. See drawings for Hardware Groups.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Glass for windows, doors, interior borrowed lites, and storefront framing.
- 2. Glazing sealants and accessories.

- B. Related Requirements:

- 1. Section 081113 "Hollow Metal Doors and Frames"
- 2. Section 084113 "Aluminum Framed Entrances and Storefronts"
- 3. Section 085113 "Aluminum Windows"
- 4. Section 085200 "Aluminum Clad Wood Windows"
- 5. Section 088300 "Mirrors"

1.3 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 C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For glass.
- C. Product Test Reports: For insulating glass for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. 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 instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 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 are below 40 deg F (4.4 deg C).

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: 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 Substantial 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 for 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 Substantial Completion

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. AGC Glass Company North America, Inc.
2. GGI; General Glass International.
3. GTI; Glaz-Tech Industries.
4. Oldcastle BuildingEnvelope™.
5. Pilkington North America.
6. Trulite Glass & Aluminum Solutions, LLC.

B. **Source Limitations for Glass:** Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.
2. Obtain reflective-coated glass from single source from single manufacturer.

C. **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 normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- C. 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 insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 2. 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 (W/sq. m x K).
 - 3. 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.
 - 4. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

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. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 4. 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 or manufacturer. 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.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, 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.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
 - 1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
 - 2. Perimeter Spacer: Aluminum with powdered metal paint finish in color selected by Architect
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they 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. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant:
 - 1. Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) GE Construction Sealants; Momentive Performance Materials Inc.
 - 2) Sika Corporation.
 - 3) The Dow Chemical Company.

- 4) Tremco Incorporated.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining 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 C1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with 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:
1. Neoprene with a Shore A durometer hardness of 85, plus or minus 5.
 2. Type recommended by sealant or glass manufacturer.
- D. Spacers:
1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 2. Type recommended by sealant or glass manufacturer.
- E. Edge Blocks:
1. Neoprene with a Shore A durometer hardness per manufacturer's written instructions.
 2. Type recommended by sealant or glass manufacturer.

- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 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.
- 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.

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 systems.
 - 3. Minimum required face and 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 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. 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.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 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 (3-mm) 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.
- G. 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.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. 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.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 GLASS SCHEDULE

- A. As indicated on the drawings.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silvered flat glass mirrors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

C. Samples: For each type of the following:

1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing and substrates on which mirrors are installed.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. 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.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.
 - 1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: Manufacturer's standard warranty from date of manufacture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. D&W, Inc.
 - 2. Majestic Mirror & Frame.
 - 3. Maryland Glass & Mirror Company.

2.2 SILVERED FLAT GLASS MIRRORS

- A. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.
 - 1. Nominal Thickness: 6.0 mm.

2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.

- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. H.B. Fuller.
 - 2. Seal Bond.
 - 3. Loctite.
- E. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

- A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
 - 1. Aluminum J-Channel Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Eagle Aluminum.
 - 2) Orange Aluminum.
 - 3) CR Laurence.
 - 2. Aluminum J-Channel Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Eagle Aluminum.
 - 2) Orange Aluminum.
 - 3) CR Laurence.
 - 3. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.5 FABRICATION

- A. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.
- B. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
- C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION 088300

SECTION 088813 - FIRE-RATED GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-rated glazing materials installed as borrowed lites in fire-rated frames.

B. Related Sections include the following:

1. Section 08 11 00 "Metal Doors and Frames" for vision panels in interior doors and interior vision panel (borrowed lites) frames.
2. Section 08 14 33 "Stile and Rail Wood Doors" for vision panels in interior doors.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E2010-01: Standard Test Method for Positive Pressure Fire Tests of Window Assemblies.

B. Glass Association of North America (GANA):

1. GANA – Glazing Manual.
2. FGMA – Sealant Manual.

C. National Fire Protection Association (NFPA):

1. NFPA 80: Fire Doors and Windows.
2. NFPA 257 – Fire Tests of Window Assemblies.

D. Underwriters Laboratories, Inc. (UL):

1. UL 9 – Fire Tests of Window Assemblies.

E. Standard Council of Canada:

1. CAN/ULC-S104 Standard Method of Fire Tests of Door Assemblies
2. CAN/ULC-S106 Standard Method of Fire Tests of Window and Glass Block Assemblies

F. 2020 Building Code of New York State.

1.3 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass, fabricated glass or framing as defined in referenced glazing publications.

1.4 SUBMITTALS

- A. Comply with requirements of Section 01 3300.

- B. Product data: Submit manufacturer's technical data for each glazing material required, including installation and maintenance instructions.
- C. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.
- D. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.
- E. Samples: Submit, for verification purposes, approx. 8-inch by 10-inch sample for each type of glass indicated.

1.5 QUALITY ASSURANCE

- A. Glazing Standards: GAMA Glazing Manual and FGMA Sealant Manual.
- B. Fire Protective Rated Glass: Each lite shall bear permanent, nonremovable label of UL certifying it for use in tested and rated fire protective assemblies.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials under provisions of Section 01 6000.
- B. Deliver materials to specified destination in manufacturer or distributor's packaging, undamaged, complete with installation instructions.
- C. Store off ground, under cover, protected from weather and construction activities.

1.7 WARRANTY

- A. Provide manufacturer's limited warranty under provision of Section 01 78 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS- (ACCEPTABLE MANUFACTURER/PRODUCTS)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. FireLite® as manufactured by Nippon Electric Glass Company, Ltd. (Basis of Design).
 - 2. Frye-Tec.
 - 3. Safti First.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-rated glass ceramic clear and wireless glazing material listed for use in non-impact safety-rated locations such as transoms and borrowed lites with fire rating requirements ranging from 20 to 90 minutes with required hose stream test.
- B. Passes positive pressure test standards UL 10C.

2.3 MATERIALS-GLASS

- A. Properties:
 - 1. Thickness: 3/16 inch [5 mm].
 - 2. Weight: 2.56 lbs/ft² or 12.5 kg/m²
 - 3. Approximate Visible Transmission: 88 percent.
 - 4. Approximate Visible Reflection: 9 percent.
 - 5. Hardness (Vicker's Scale): 700.
 - 6. Fire-rating: 20 minutes to 90 minutes.
 - 7. Impact Safety Resistance: None.
 - 8. Positive Pressure Test: UL 10C; passes.
 - 9. Surface Finish:
 - a. Standard Grade is polished for a surface quality that is comparable to alternative fire-rated ceramics marketed as having a premium finish.
 - b. Premium Grade is finish ground and polished on both surfaces to provide superior surface quality, improving overall clarity and providing a surface that is unmatched by alternative products.
 - c. Obscure-Patterned surface for privacy
 - 10. Positive Pressure Test: UL 10C; passes.
- B. Maximum sheet sizes based on surface finish:
 - 1. Premium: 48 inches by 96 inches.
 - 2. Standard: 48 inches by 96 inches.
 - 3. Obscure: 36 inches by 96 inches.
- C. Labeling: Permanently label each piece of FireLite® with the FireLite® logo, UL logo and fire rating in sizes up to 3,325 sq. in., and with the FireLite® label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).
- D. Fire Rating: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with [ASTM E2010-01] [ULC Standards CAN4 S-104 and CAN4 S-106] [NFPA 257] [UL 9 and UL 10B].
- E. Substitutions: No substitutions permitted.

2.4 GLAZING COMPOUND FOR FIRE-RATED GLAZING MATERIALS

- A. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that

exceed 1,393 sq. inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.

- B. [Glazing Compound: DAP 33 putty.]
- C. [Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Available Products:
 - 1. Dow Corning 795 - Dow Corning Corp.
 - 2. Silglaze-II 2800 - General Electric Co.
 - 3. Spectrem 2 - Tremco Inc.
- D. Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
- E. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.5 FABRICATION

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
 - 2. Minimum required face or edge clearances.
 - 3. Observable edge damage or face imperfections.
- B. Do not proceed with glazing until unsatisfactory conditions have been corrected.
- C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.2 INSTALLATION (GLAZING)

- A. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.

- B. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- C. Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.
- D. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
- E. Place setting blocks located at quarter points of glass with edge block no more than 6 inches from corners.
- F. Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- G. Place glazing tape on free perimeter of glazing in same manner described above.
- H. Install removable stop and secure without displacement of tape.
- I. [Use specified glazing compound, without adulteration; bed glazing material in glazing compound; entirely fill all recess and spaces. Provide visible glazing compound with smooth and straight edges.]
- J. Install so that appropriate [UL] [FireLite®] markings remain permanently visible.

3.3 PROTECTION AND CLEANING

- A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.
- B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.

3.4 GLAZING SCHEDULE

Rating	Assembly	Max. Exposed Area (Sq. In.)	Max. Width Of Exposed Glazing (In.)	O R	Max. Height Of Exposed Glazing (In.)	Stop Height
20 to 60 min.	Other than doors					
	HMS or wood* Fireframes® D.S.	3,325 3,325	95 95		95 95	5/8" 3/4"
90 min.	Other than doors					
	HMS	2,627	56 1/2"		56 1/2"	5/8"
	Fireframes D.S.	2,627	56 1/2"		56 1/2"	3/4"

* HMS indicates hollow metal steel framing. Fireframes® D.S. indicates Designer Series narrow profile framing available from TGP. For wood frames, check with manufacturer for maximum tested glass sizes.

END OF SECTION

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated on Drawings
- B. Gypsum Shaftliner Board:
 - 1. Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, **1 inch (25.4 mm)** thick, with double beveled long edges.
 - a. USG
 - b. American Gypsum
 - c. Certainteed
- C. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
- D. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
 - 1. Depth: As indicated on Drawings.
 - 2. Minimum Base-Metal Thickness: As indicated on Drawings.

- E. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least **2 inches (51 mm)** long and matching studs in depth.
- F. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- G. Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board."

2.3 AUXILIARY MATERIALS

- A. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
- C. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
- D. Reinforcing: Galvanized-steel reinforcing strips with **0.033-inch (0.84-mm)** minimum thickness of base metal (uncoated).
- E. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged.
- D. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
 - 1. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

- E. Penetrations: Install supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.
- F. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- G. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- H. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by faces of adjacent framing.
- I. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION 092116.23

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Framing systems.
 - 2. Suspension systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation reports for high-strength steel studs and tracks.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association or the Steel Stud Manufactures Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated.
 2. Protective Coating: Comply with ASTM A653/A653M, **G40 (Z120)**; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
- B. Studs and Track: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. **ClarkDietrich.**
 - b. **Marino\WARE.**
 2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
 3. Depth: As indicated in Drawings.
- C. Slip-Type Head Joints: Where indicated, provide[**one of**] the following:
1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing **1-1/2-inch (38-mm)** minimum vertical movement.
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1) **ClarkDietrich.**
 - 2) **Marino\WARE.**
 2. Single Long-Leg Track System: Top track with **2-inch- (51-mm-)** deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within **12 inches (305 mm)** of the top of studs to provide lateral bracing.
 3. Double-Track System: Top outer tracks, inside track with **2-inch- (51-mm-)** deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1) **ClarkDietrich.**
 - 2) **Marino\WARE.**

- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Steel Thickness: **0.0329 inch (0.836 mm)**
- F. Cold-Rolled Channel Bridging: Steel, **0.0538-inch (1.367-mm)** minimum base-steel thickness, with minimum **1/2-inch- (13-mm-)** wide flanges.
1. Depth: As indicated on Drawings.
 2. Clip Angle: Not less than **1-1/2 by 1-1/2 inches (38 by 38 mm)**, **0.068-inch- (1.72-mm-)** thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. Marino\WARE.
 2. Minimum Base-Steel Thickness: **0.0296 inch (0.752 mm)**.
 3. Depth: As indicated on Drawings.
- H. Resilient Furring Channels: **1/2-inch- (13-mm-)** deep, steel sheet members designed to reduce sound transmission.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. Marino\WARE.
 2. Configuration: hat shaped.
- I. Cold-Rolled Furring Channels: **0.053-inch (1.34-mm)** uncoated-steel thickness, with minimum **1/2-inch- (13-mm-)** wide flanges.
1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of **0.0329 inch (0.8 mm)**.
 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, **0.062-inch- (1.59-mm-)** diameter wire, or double strand of **0.048-inch- (1.21-mm-)** diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of **1-1/4 inches (32 mm)**, wall attachment flange of **3/4 inch (19 mm)**, minimum uncoated-steel thickness of **0.0179 inch (0.455 mm)**, and depth required to fit insulation thickness indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [ClarkDietrich](#).
- b. [Marino\WARE](#).

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, **0.062-inch- (1.59-mm-)** diameter wire, or double strand of **0.048-inch- (1.21-mm-)** diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES [AC01] [AC193] [AC58] [or] [AC308] as appropriate for the substrate.
 - a. Uses: Securing hangers to structure..
 - b. Type: Torque-controlled, expansion anchor torque-controlled, adhesive anchor or adhesive anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or **ASTM F1941 (ASTM F1941M)**, Class Fe/Zn 5, unless otherwise indicated.
 - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy **Group 1 (A1)** stainless steel bolts, **ASTM F593 (ASTM F738M)**, and nuts, **ASTM F594 (ASTM F836M)**.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, **0.16 inch (4.12 mm)** in diameter.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of **0.0538 inch (1.367 mm)** and minimum **1/2-inch- (13-mm-)** wide flanges.
 - 1. Depth: **2 inches (51 mm)**.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: **0.0538-inch (1.367-mm)** uncoated-steel thickness, with minimum **1/2-inch- (13-mm-)** wide flanges, **3/4 inch (19 mm)** deep.
 - 2. Steel Studs and Tracks: Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
 - a. Minimum Base-Steel Thickness: **0.0269 inch (0.683 mm)**.
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: **7/8 inch (22 mm)** deep.
 - a. Minimum Base-Steel Thickness: **0.0296 inch (0.752 mm)**.
 - 4. Resilient Furring Channels: **1/2-inch- (13-mm-)** deep members designed to reduce sound transmission.
 - a. Configuration: hat shaped.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide[**one of**] the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch (3.2 mm)** thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch (13-mm)** clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs **6 inches (150 mm)** o.c.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
- F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced [24 inches (610 mm)] <Insert dimension> o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLATION OF SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

- 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Installation Tolerances: Install suspension systems that are level to within **1/8 inch in 12 feet (3 mm in 3.6 m)** measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protect against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. Georgia-Pacific Gypsum LLC.
 - c. National Gypsum Company.
 - d. USG Corporation.
- 2. Thickness: **1/2 inch (12.7 mm)**.
- 3. Long Edges: Tapered.

- B. Gypsum Board, Type X: ASTM C1396/C1396M.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
 - c. National Gypsum Company.
 - d. USG Corporation.
- 2. Thickness: **5/8 inch (15.9 mm)**.
- 3. Long Edges: Tapered.

- C. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
2. Thickness: **1/2 inch (12.7 mm)**.
3. Long Edges: Tapered.

D. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
 - c. National Gypsum Company.
 - d. USG Corporation.
2. Core: **5/8 inch (15.9 mm)**, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - d. USG Corporation.
2. Core: **5/8 inch (15.9 mm)**, Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

- a. Cornerbead.
- b. Bullnose bead.
- c. LC-Bead: J-shaped; exposed long flange receives joint compound.
- d. L-Bead: L-shaped; exposed long flange receives joint compound.
- e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- f. Expansion (control) joint.
- g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. Exterior Gypsum Soffit Board: Paper.
 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
- E. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound
- F. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels. Reference reflected plans for patterns and locations.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Type X: Where required for fire-resistance-rated assembly.
 - 3. Ceiling Type: Ceiling surfaces.
 - 4. Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

3.5 Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces installing trim accessories.

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners.

3.6 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

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. Porcelain tile.
 - 2. Thresholds.
 - 3. Waterproof membrane for thinset applications.
 - 4. Crack isolation membrane.
 - 5. Metal edge strips.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 2. Section 092900 "Gypsum Board" for cementitious backer units.
 - 3. Drawing I001 "Color and Finish Legend and Interior Details" for owner approved basis-of-design selections.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- D. Samples for Verification:
 1. Full-size units of each type and composition of tile and for each color and finish required.
 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 3. Full-size units of each type of trim and accessory for each color and finish required.
 4. Stone thresholds in 6-inch lengths.
 5. Metal edge strips in 6-inch lengths.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
2. Installer employs Ceramic Tile Education Foundation Certified Installers.
3. Installer is a member, in good standing, of Trowel of Excellence, or NTCA 5 star rated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has a temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding before setting tile.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
 3. Provide setting materials warranty, from single sourced manufacturer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
1. Stone thresholds.
 2. Waterproof membrane.
 3. Crack isolation membrane.
 4. Cementitious backer units.
 5. Metal edge strips.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

- A. Porcelain Tile Type **CT2-4**:
1. **Basis-of-Design Product**: Subject to compliance with requirements, **provide Crossville Color By Numbers** or comparable product by one of the following:
 - a. Daltile
 - b. Florida Tile
 - c. WOW Tile.
 2. Composition: Porcelain.
 3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.

4. Module Size: See Drawing I001 "Color and Finish Legend and Interior Details".
5. Thickness: ¼" thick.
6. Face: Refer to Drawing Series I001 Color and Finish Legend.
7. Tile Color, Pattern & Grout Color: Refer to Drawing I001 "Color and Finish Legend and Interior Details".

B. Ceramic Tile Type (CT-1): Factory-mounted porcelain mosaic tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Crossville Inc. Color Blox 2.0 Mosaics** or comparable product by one of the following:
 - a. Daltile
 - b. Florida Tile
 - c. Anatolia Tile & Stone
 - d. WOW Tile
2. Composition: Porcelain.
3. Module Size: 3 by 3 inches.
4. Thickness: 1/4 inch (6.35 mm).
5. Face: Plain with cushion edges.
6. Surface: Smooth, without abrasive admixture.
7. Finish: Mat, clear glaze.
8. Tile Color and Pattern: Refer to Drawing Series I001 Color and Finish Legend.
9. Grout Color: Refer to Drawing Series I001 Color and Finish Legend.
1. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cove: Cove, module size.

2.4 THRESHOLDS

- A. General: Provide sizes and profiles as indicated or required to provide ADA compliant transition between adjacent floor finishes.

2.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
 1. Thickness: 5/8 inch.

2.6 WATERPROOF AND CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Laticrete Hydro Ban** or comparable product by one of the following:
 - a. Bostik
 - b. Custom Building Products.
 - c. MAPEI
2. Provide compatible sheet membrane where cracks 1/8" or greater occur.

2.7 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Laticrete 253 Gold** or comparable product by one of the following:
 - a. Bostik
 - b. Custom Building Products.
 - c. MAPEI
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
4. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to the other requirements in ANSI A118.4.

B. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Laticrete 3701 Fortified Mortar** polymer modified mortar or comparable product by one of the following:
 - a. Bostik
 - b. Custom Building Products.
 - c. MAPEI
2. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick.
3. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A185/A185M and ASTM A82/A82M, except for minimum wire size.
4. Expanded Metal Lath: Diamond-mesh lath complying with ASTM C847.
 - a. Base Metal and Finish for Interior Applications: Uncoated or zinc-coated (galvanized) steel sheet, with uncoated steel sheet painted after fabrication into lath.
 - b. Configuration over Solid Surfaces: Self-furring.
 - c. Weight: 2.5 lb/sq. yd. (1.4 kg/sq. m).

2.8 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Basis-of-Design Product: Subject to compliance with requirements, provide **Laticrete Spectralock Pro Premium Grout** or comparable product by one of the following:
 - a. Bostik
 - b. Custom Building Products.
 - c. MAPEI
2. Provide product with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.
3. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

2.9 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the applicable requirements in Section 079200 "Joint Sealants."
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
 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. Basis of Design Product: Laticrete Latasil
 - 1) Match colors of grouts used in project
 - b. Bostik
 - c. Custom Building Products.
 - d. MAPEI
 2. Provide sealant at edges of wall tile installations where wall tile meets ceiling grid and at all inside corners as well as all joints indicated in current TCNA EJ171 standard.

2.10 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils thick.
- C. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, designed specifically for flooring and wall applications.
 1. Wall Tile outside corner metal edge strip:
 - a. Basis of Design Product: Schluter Rondec, Stainless Steel (**TS-1**)

2. Floor Transition Tile to VCT/LVT:
 - a. Basis of Design Product: Schluter RENO-U, Satin Anodized Aluminum (TS-4)

- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.11 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 2. Verify that concrete substrates for tile floors installed with adhesives bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Exterior tile floors.
 - b. Tile floors in wet areas.
 - c. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.
 - d. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Porcelain Tile: refer to Drawing Series I-001 Color and Finish Legend
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
- J. Movement joints: Provide appropriate elastomeric sealant in the following joints. **Do not grout these joints:**
1. Perimeter expansion, where Floor Tile meets Wall Tile.
 2. Walls at inside corners.
 3. Walls where Wall Tile meets door and window frames.
- K. All Movement, Control, and Expansion Joints per TCNA EJ171.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- L. Metal Edge Strips: Install at locations indicated.
- M. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
 2. Do not extend waterproofing or crack isolation membrane under thresholds set in dry-set Portland cement or latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing or crack isolation membrane with elastomeric sealant.
- N. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- 3.4 TILE BACKING PANEL INSTALLATION
- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.
 - a. Tile Type: CT1
 - b. Thin-Set Mortar: Latex- portland cement mortar.
 - c. Grout: Water-cleanable epoxy grout.
 - d. Locations: Toilet Rooms & Shower Room.

B. Interior Floor Installations, Wood Subfloor with waterproof membrane:

- a. Tile Type: CT1
- b. Thin-Set Mortar: Latex- portland cement mortar.
- c. Grout: Water-cleanable epoxy grout.
- d. Locations: Toilet Rooms 210A, 211A, 310A

C. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Tile Installation: TCNA W244C-17; thinset mortar on cementitious backer units or fiber-cement backer board with waterproof membrane.
 - a. Tile Type: CT2-4
 - b. Standard Dry-Set Mortar (Thinset): Polymer modified non-sag mortar.
 - c. Grout: Water-cleanable epoxy grout.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Related Requirements:
 - 1. Drawing I-001 "Color and Finish Legend and Interior Details" for owner approved basis-of-design selections.
- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Initial Selection: For components with factory-applied finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Tiles: Set of full size samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.
 - 3. Clips: Full-size hold-down clips.
 - 4. Seismic Clips: Full size.
- E. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 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-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

- B. Qualification Data: For testing agency.

- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E 1264.
 - 2. Smoke-Developed Index: 50 or less.
- D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS (ACT-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **CertainTeed Architectural Ceiling Systems Ecophon Focus Ds Series - Fully Concealed** Acoustical Ceiling Panels or a comparable product by one of the following:
 - 1. USG Ceiling Solutions.
 - 2. Armstrong World Industries.
 - 3. Rockfon
- B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide tiles as follows:
 - 1. Type and Form: Type XII, Form 1.
 - 2. Pattern: G.
- D. Color: Refer to Drawing I-001 "Color and Finish Legend and Interior Details".
- E. Light Reflectance (LR): Not less .85.

- F. Ceiling Attenuation Class (CAC): Not less than 35.
- G. Noise Reduction Coefficient (NRC): Not less than 0.75.
- H. Edge/Joint Detail: Fully concealed.
- I. Thickness: 3/4 inch.
- J. Modular Size: 2'-0" x 4'-0".
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 ACOUSTICAL PANELS (ACT-2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Armstrong World Industries Ceilings, Clean Room Mylar** Acoustical Panels or a comparable product by one of the following:
 - 1. USG Ceilings.
 - 2. CertainTeed Corp. Ceilings
 - 3. Rockfon
- B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide tiles as follows:
 - 1. Type and Form: Type IV, Form 2
 - 2. Pattern: Pattern E
- D. Color: Refer to Drawing I-001 "Color and Finish Legend and Interior Details".
- E. Light Reflectance (LR): Not less than 0.79.
- F. Ceiling Attenuation Class (CAC): Not less than 30.
- G. Edge/Joint Detail: Square Lay-in.
- H. Thickness: 5/8 inch.
- I. Modular Size: 2'-0" x 2'-0".
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.5 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide product by **CertainTeed Architectural Ceiling Systems**, or comparable product by one of the following for **ACT-1:**
- a. USG Ceiling Solutions.
 2. Armstrong World Industries.
 - a. Rockfon.
 3. Basis of Design Product: **EZ Stab Classic**
 - a. Type 15/16 inch (Typical unless otherwise noted):
 - b. 15/16" Wide-Face
 - c. Pre-painted, hot-dip galvanized coating according to ASTM A 653.
 - d. Steel cap, finished.
 - e. Color: Flat white.
 - f. Structural Classification: Heavy-duty system.
- B. Manufacturers: Subject to compliance with requirements, provide product by **Armstrong World Industries Ceilings**, or comparable product by one of the following for **ACT-2:**
- a. USG Ceiling Solutions.
 - b. CertainTeed Corp. Ceilings.
 - c. Rockfon.
 2. Basis of Design Product: **Prelude 5/16**
 - a. Type 15/16 inch (Typical unless otherwise noted):
 - b. 15/16" Wide-Face
 - c. Pre-painted, hot-dip galvanized coating according to ASTM A 653.
 - d. Steel cap, finished.
 - e. Color: Flat white.
 - f. Structural Classification: Heavy-duty system.

2.6 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Cast-in-place anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory

devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- F. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches on center, on all cross tees.
1. Provide hold-down clips at all entrance vestibules.
 2. Where entrance does not include a vestibule, provide hold-down clips 10 feet into the lobby or corridor.
- G. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- H. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- I. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.7 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.8 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - b. Install panels with pattern running in one direction parallel to long axis of space, or as indicated on drawings.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 6. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches (610 mm) o.c. on all cross runners.
 7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
 8. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 - 1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and post-installed anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two post-installed anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096400 - WOOD FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Field-finished wood flooring.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details.
- C. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hardwood Flooring: Comply with NWFA A500 for species, grade, and cut.
1. Certification: Provide flooring that carries NWFA grade stamp on each bundle or piece.

2.2 FIELD-FINISHED WOOD FLOORING

- A. Solid-Wood Flooring, Field-Finished: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; with backs channeled.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bruce Hardwood Floors.
 2. Hartco.
 3. Mohawk.
- C. Grade and Species: To match existing salvaged stock for grade and species.
- D. Cut: To match existing salvaged stock.
1. Thickness: 3/4 inch (19 mm).
 2. Face Width: Match existing salvaged stock.
 3. Lengths: Manufacturer's standard.

- E. Urethane Finish System: Complete water-based system of compatible components that is recommended by finish manufacturer for application indicated.
- F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Minwax.
 - 2. Bona.
 - 3. Rockler.
- G. Stain: Penetrating and nonfading type.
 - a. Color: As selected by Architect from manufacturer's full range.
- H. Floor Sealer: Pliable, penetrating type.
- I. Finish Coats: Formulated for multicoat application on wood flooring.
- J. Wood Filler: Compatible with finish system components and recommended by filler and finish manufacturers for use indicated. If required to match approved Samples, provide pigmented filler.

2.3 ACCESSORY MATERIALS

- A. Wood Underlayment: As specified in Section 061600 "Sheathing."
- B. Vapor Retarder: ASTM D4397, polyethylene sheet not less than indicated on the drawings.
- C. Asphalt-Saturated Felt: ASTM D4869/D4869M, Type II.
- D. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.
- E. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.
- F. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines."
- G. Thresholds and Saddles: To match wood flooring. Tapered on each side.
- H. Reducer Strips: To match wood flooring. 2 inches (51 mm) wide, tapered, and in thickness required to match height of flooring.
- I. Feature Strips: 2-inch- (51-mm-) wide, square-edged walnut strips, furnished in lengths as long as practical and in thickness to match wood flooring.
- J. Wood Air Vents and Grilles: To match wood flooring and in sizes and design indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 80 percent relative humidity level measurement.
 - b. Perform additional moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. Concrete Slabs:

1. Grind high spots and fill low spots to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.
2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
3. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

- ##### B. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- ##### A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines."

- ##### B. Wood Underlayment: Install according to requirements in Section 061600 "Sheathing."

- ##### C. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 3/4 inch (19 mm).

- ##### D. Vapor Retarder: Comply with the following for vapor retarder installation:

1. Wood Flooring Nailed to Wood Subfloor: Install flooring over a layer of asphalt-saturated felt.
2. Wood Flooring Nailed to Sleepers over Concrete: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.

3. Wood Flooring Installed Directly on Concrete: Install a layer of polyethylene sheet according to flooring manufacturer's written instructions.
- E. Sound Control Underlayment: Install over vapor retarder according to manufacturer's written instructions.
- F. Solid-Wood Flooring: Blind nail or staple flooring to substrate.

3.4 FIELD FINISHING

- A. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that are noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.
 1. Comply with applicable recommendations in NWFA's "Installation Guidelines."
- B. Fill open-grained hardwood.
- C. Fill and repair wood flooring defects.
- D. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated, but not less than one coat of floor sealer and three finish coats.
 1. Apply stains to achieve an even color distribution matching approved Samples.
 2. For water-based finishes, use finishing methods recommended by finish manufacturer to minimize grain raise.
- E. Cover wood flooring before finishing.
- F. Do not cover wood flooring after finishing until finish reaches full cure, and not before seven days after applying last finish coat.

3.5 PROTECTION

- A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.
 1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096400

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Resilient base.
- 2. Resilient molding accessories.
- 3. Resilient stair treads

- B. Related Sections:

- 1. Drawing Series I-001 "COLOR AND FINISH LEGEND" for owner approved basis-of-design selections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- E. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Coordinate mockups in this Section with mockups specified in other Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE (**RB1**)

- 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. Tarkett (Basis of Design)
 2. Roppe Corporation.
 3. Nora Systems.
 4. Flexco.
- B. Basis-of-Design: Subject to compliance with requirements, provide **Tarkett Baseworks Thermoset Rubber Wall Base**.
- C. Product Standard: ASTM F 1861, Type TS (rubber, thermoset).
1. Group: I (solid, homogeneous) or II (layered).
 2. Style and Location:

- a. Style B, Cove: Provide in areas with resilient and carpet flooring (RB1).
3. Thickness: 0.125 inch.
4. Height: 4 inches (102 mm).
5. Lengths: Coils in manufacturer's standard length.
6. Outside Corners: Job formed.
7. Inside Corners: Job formed.
8. Colors: As indicated on Drawing I-001 "Color and Finish Legend and Interior Details" or as selected by Architect from full range of industry colors.

2.2 RUBBER STAIR ACCESSORIES (**RST1**)

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Basis-of-Design: Subject to compliance with requirements, provide **Johnsonite Visually Impaired Angle Fit Rubber Stair Treads** or comparable product by one of the following:
 1. Tarkett (Basis of Design)
 2. Roppe Corporation.
 3. Nora Systems.
 4. Flexco.
- C. Stair Treads: ASTM F 2169.
 1. Type: TS (rubber, vulcanized thermoset).
 2. Class: 2 (pattern; embossed, grooved, or ribbed).
 3. Group: 2 (with contrasting color for the visually impaired).
 4. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
 5. Nosing Height: 1-1/2 inches (38 mm).
 6. Thickness: 1/4 inch (6 mm) and tapered to back edge.
 7. Size: Lengths and depths to fit each stair tread in one piece.
 8. Visually Impaired Nosing Strip: Solid color rubber insert; black.
- D. Landing Tile (**RBF1**): See drawings; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
 1. Basis-of-Design: Subject to compliance with requirements, provide **Johnsonite Solid Color Rubber Tile** or comparable product.
- E. Locations: Provide rubber stair accessories in areas indicated on drawings.
- F. Colors and Patterns: As indicated on Drawing I-001 "Color and Finish Legend" or as selected by Architect from full range of industry colors.

2.3 RESILIENT MOLDING ACCESSORY / TRANSITION STRIP (**TS**)

- A. Basis-of-Design: Subject to compliance with requirements, provide Tarkett Finishing Accessories or comparable product.

- B. Description: Carpet edge for glue-down applications, reducer strip for resilient flooring and joiner for tile and carpet, transition strips.
- C. Profile and Dimensions: As indicated on Drawing I-001 “Color and Finish Legend and Interior Details”.
- D. Locations: Provide resilient molding accessories in areas indicated.
- E. Colors and Patterns: As indicated on Drawing I-001 “Color and Finish Legend and Interior Details” or as selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum horizontal surfaces thoroughly.
 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 1. Apply per manufacturer's written instructions.
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Luxury Vinyl tile

- B. Related Sections:

- 1. Drawing Series I-001 "COLOR AND FINISH LEGEND" for owner approved basis-of-design selections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For each type of floor tile.

- 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

- 2. Show details of special patterns.

- C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

- D. Flooring and Adhesive Manufacturer recommended Moisture, Alkalinity, and Adhesion Tests.

- 1. Prior to Testing, submit PLAN (drawings) of proposed Test locations to Architect.

- 2. Results of Tests shall be submitted to Architect prior to Pre-Installation Conference for review.

- E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in 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. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

- 1. Engage installer employing workers for this Project trained or certified by manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F For more than 90 deg F, in spaces to receive floor tile during the following time periods:

- 1. 48 hours before installation.
- 2. During installation.
- 3. 48 hours after installation.

- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

- C. Close spaces to traffic during floor tile installation.

- D. Close spaces to traffic for 48 hours after floor tile installation.

- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 LUXURY VINYL TILE (LVT-1 – 2)

- A. Basis of Design Product: Subject to compliance with requirements, provide **Interface Natural Woodgrains LVT** or comparable product by one of the following:
1. Tarkett
 2. Mannington Commercial
 3. Mohawk Group
 4. Shaw Contract
- B. Tile Standard: ASTM F1700, Class III Printed Vinyl Plank
- C. Wearing Surface: Embossed
- D. Thickness: 4.5 mm
- E. Size: 25 cm x 1 M
- F. Wear Layer Thickness: 22 mil
- G. Colors and Patterns: Refer to Drawing I001 “COLOR AND FINISH LEGEND AND INTERIOR DETAILS”.

2.3 HOMOGENEOUS VINYL FLOOR TILE (SDT1)

- A. Basis-of-Design Product: Subject to compliance with requirements, **Tarkett, IQ Granit** tile or a comparable product by one of the following:
1. Armstrong Flooring.
 2. Forbo
 3. Gerflor
- B. Tile Standard: ASTM F1700.
1. Class: Class I, Monolithic Vinyl Tile.
 2. Type: A, Smooth Surface.
- C. Thickness: 0.080 inch (2.0 mm).

- D. Size: 24 by 24 inches (610 by 610 mm).
- E. Colors and Patterns: refer to Drawing Series I-001 "Color and Finish Legend" for owner approved finishes.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.
- D. Moisture Vapor Retarder: Provide moisture mitigation system all all at or below grade locations of resilient tile flooring. See 035416 and 090561.13 for required underlayment and moisture mitigation information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. **Do not use solvents.**

3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaces in installation areas.
 - a. Anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water / 1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Both tests shall be performed according to testing methods described in referenced standards.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
 - a. Flash patch and double skim- coat in the areas scheduled to receive resilient flooring where required. Floor tolerance prior to installation of new resilient flooring shall be 1/8" in 10'-0" by use of a straight edge in any direction. Skim coat material shall be ground to a smooth finish prior to finish floor installation. Floor level to be approved by Architect prior to finish floor installation.
 - b. **Provide full spread of hydraulic cement underlayment at all resilient tile flooring locations.**
- D. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- E. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles in pattern indicated on drawings or square with room axis.

- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain running in one direction as indicated in drawings.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Strictly comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation, or in time limit indicated by manufacturer's written instructions:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient floor tile surfaces before applying liquid cleaners, sealers, and finish products.
- E. Cover floor tile until Substantial Completion.

3.5 WARRANTY

- A. In addition to manufacturers product warranty. Installer shall provide one (1) year unconditional warranty to re-install flooring that failed based on original installation methods.

LaBella Associates, D.P.C.
Project No. 2221723

Academic Innovation Hub
Work Force Development Training
Niagara University

April 2024

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

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 modular carpet tile.
- B. Related Requirements:
 - 1. Section 024119 "Selective Demolition" for removing existing floor coverings.
 - 2. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
 - 3. Drawing Series I-001 "COLOR AND FINISH LEGEND" for owner approved basis-of-design selections.

1.3 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.

3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

E. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.10 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, runs, stretching, doming, cupping or shrinking.
 - b. Excessive surface wear measured by the loss of more than 10 percent of face fiber by weight.
 - c. Dimensional instability.
 - d. Excess static discharge.
 - e. Loss of tuft-bind strength.
 - f. Delamination.
 - 3. Warranty Period: Interface Standard Product Warranty for the Americas - 15 years from the date of invoice.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT1-3)

- A. **Manufacturers:** Subject to compliance with requirements, provide **Interface, Inc.** or a comparable product by one of the following:
- a. Milliken
 - b. Mannington Commercial
 - c. Mohawk Group
 - d. Shaw Contract
2. Basis of Design Product: **Aerial Collection, Pattern: AE311, AE315, AE317.**
 3. Color: As indicated on I001 Color and Finish Legend.
 4. Fiber Content: 100% Recycled Content Nylon, 100% Solution Dyed.
 5. Product Construction: Tufted Textured Loop.
 6. Pile Thickness: 2.6 mm.
 7. Pile Height: 3.3 mm.
 8. Tufted Yarn Weight: 17 oz./Square Yard.
 9. Pile Density: 6,059 oz./Cubic Yard.
 10. Backing System: GlassBac.
 11. Size: 25cm x 1m.
 12. Applied Treatments: Protekt Soil/Stain Protection.
 - a. Intersept Preservative Protection.
 13. Traffic Classification: Heavy.

2.2 ENTRANCE MAT TILE (EM1)

- A. **Manufacturers:** Subject to compliance with requirements, provide **Interface, Inc.** or a comparable product by one of the following:
- a. Milliken
 - b. Mannington Commercial
 - c. Mohawk Group
 - d. Shaw Contract
2. Basis of Design Product: **Step Repeat Collection: SR999.**
 3. Color: As indicated on I001 Color and Finish Legend.
 4. Fiber Content: 100% Recycled Content Nylon, 100% Solution Dyed.
 5. Product Construction: Tufted Textured Loop.
 6. Pile Thickness: 3.2 mm.
 7. Pile Height: 4.3 mm.
 8. Tufted Yarn Weight: 27 oz./Square Yard.
 9. Pile Density: 7654 oz./Cubic Yard.
 10. Backing System: GlassBac.
 11. Size: 50 cm x 50 cm.
 12. Applied Treatments: Protekt Soil/Stain Protection.
 - a. Intersept Preservative Protection.
 13. Traffic Classification: Severe.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform the (3) test locations for areas up to 1,000 square feet, and one additional test for each additional 1,00 square feet or fraction thereof.
 - d. Test units should not be concentrated, but shall be located in various parts of the floor area. One unit shall be placed near center with others being placed around perimeter. Selection of test sites shall include areas of potential moisture, including joints and perimeter of building.
- D. Wood Subfloors: Verify the following:
 - 1. Underlayment over subfloor complies with requirements specified in Section 061600 "Sheathing."
 - 2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
- E. Metal Subfloors: Verify the following:

1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

Retain or revise first paragraph below to suit product and Project; dimensions are recommended by CRI.

- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

- B. Installation Method: As recommended in writing by carpet tile manufacturer.

- C. Maintain dye-lot integrity. Do not mix dye lots in same area.

- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099113 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on exterior substrates.
 - 1. Steel and iron.
 - 2. Concrete masonry units (CMUs).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore & Co.
 2. PPG Paints.
 3. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, provide product listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer. but not less than the following:
 1. SSPC-SP 11.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Paint entire exposed surface of window frames and sashes.
 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 1. Paint the following work where exposed to view:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.

- d. Metal conduit.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. METAL: Misc. Iron, and Steel, Ferrous Metal.
 - 1. Latex Systems:
 - a. Prime Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0-10.0 mils wet, 1.8-3.6 mils dry).
 - b. Intermediate Coat: S-W A-100 Exterior Latex Gloss, A8 Series.
 - c. Topcoat: S-W A-100 Exterior Latex Gloss, A8 Series (4.0 mils wet, 1.3 mils dry per coat), gloss finish.
- B. Concrete Masonry Unit Substrates:
 - 1. Latex over Alkali-Resistant Primer System:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, flat.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete masonry units (CMUs).
 - 2. Steel and iron.
 - 3. Aluminum (not anodized or otherwise coated).
 - 4. Wood.
 - 5. Gypsum board.
 - 6. Plaster.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
 - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
 - 3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
 - 4. Section 057113 "Fabricated Metal Spiral Stairs" for shop priming and painting of stairs.
 - 5. Section 055213 "Pipe and Tube Railings" for shop painting pipe and tube railings.
 - 6. Section 099600 "High-Performance Coatings" for tile-like coatings.
 - 7. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
 - 8. Drawing Series I-001 "COLOR AND FINISH LEGEND" for owner approved basis-of-design selections.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

Color and gloss of Samples change as they age; seven-day old Samples appear different from freshly dried Samples.

- 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); or a comparable product by one of the following:
 1. Benjamin Moore
 2. PPG
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: Refer to Drawing Series I-001 "COLOR AND FINISH LEGEND" for owner approved finishes.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Fiber-Cement Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Gypsum Board: 12 percent.

6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
 1. SSPC-SP 2.
 2. SSPC-SP 3.
 3. SSPC-SP 7/NACE No. 4.
 4. SSPC-SP 11.

- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 - 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4 X-Green:
 - 1) S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - f. Topcoat: Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - 1. Water-Based Light Industrial Coating System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4 X-Green:
 - 1) S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
 - c. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - e. Topcoat: Light industrial coating, interior, water based, eggshell, (Gloss Level 3), MPI #151:
 - 1) S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- B. Metal Substrates (Aluminum, Steel, Galvanized Steel):
 - 1. Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based, MPI #107:
 - 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
 - c. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
 - d. Topcoat: Water-based acrylic, semi-gloss, (Gloss Level 5), MPI #147 X-Green:
 - 1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
 - 1. Water-Based Dry-Fall System:
 - a. Base Coat: Dry-fall latex, flat, MPI #118:
 - 1) S-W Pro Industrial Waterborne Acrylic Dry-fall Flat, B42-80 Series, at 6.0 mils wet, 1.7 mils dry.
 - b. Top Coat: Dry-fall latex, flat, MPI #118:
 - 1) S-W Pro Industrial Waterborne Acrylic Dry-fall Flat, B42-80 Series, at 6.0 mils wet, 1.7 mils dry.
- A. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #39:

- 1) S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
- c. Intermediate Coat: Latex, interior, matching topcoat.
- f. Topcoat: Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green:
- g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 4), MPI #43 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- 1. Acrylic/Alkyd System:
 - a. Prime Coat: Primer sealer, latex, interior: S-W Premium Wall & Wood Primer, B28W8111, at 4.0 mils wet, 1.8 mils dry.
 - c. Intermediate Coat: Urethane alkyd, interior, matching topcoat.
 - d. Topcoat: Water-based acrylic-alkyd, semi-gloss, interior:
 - 1) S-W Pro Industrial Urethane Alkyd Enamel, B54-150 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- D. Gypsum Board Plaster and Spray-Texture Ceiling Substrates:
 - 2. Latex System:
 - a. Prime Coat: Primer, latex, interior, MPI #149 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - f. Ceilings: Topcoat: Latex, interior, low sheen, (Gloss Level 2), MPI #44 X-Green/#144 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - g. Walls: Topcoat: Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - 1. Water-Based Light Industrial Coating System (EPT):
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - c. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - e. Topcoat: Light industrial coating, interior, water based, eggshell, (Gloss Level 3), MPI #151:
 - 1) S-W Pro Industrial Pre-Catalyzed Water-based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- B. Gypsum Board Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer, latex, interior, MPI #149 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Latex, interior, eggshell, (Gloss Level 3), MPI #52 X-Green/#145 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

- F. Gypsum Board Ceiling Substrates:
 - 2. Latex System:
 - a. Prime Coat: Primer, latex, interior, MPI #149 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Ceilings: Topcoat: Latex, interior, low sheen, (Gloss Level 2), MPI #44 X-Green/#144 X-Green:
 - 1) S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

1.1 SUMMARY

- A. Section Includes:
1. Primers
 2. Wood stains.
 3. Transparent finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of finish system and in each color and gloss of finish required.
- C. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MOCKUPS

- A. Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals and to set quality standards for materials and execution.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Minwax.
 - b. Rust-Oleum.
 - c. Cascade Coatings.
 - d. Varathane.
 - e. Ronseal.

2.2 MATERIALS, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Stain Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

- A. Alkyd Sanding Sealer, Interior, Solvent Based, Clear: Solvent-based, quick-drying, clear, sandable alkyd sealer used on new interior wood surfaces that are to be top-coated with an alkyd varnish.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Minwax.
 - b. Rust-Oleum.
 - c. Zinsser.

2.4 WOOD STAINS

- A. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Minwax.
 - b. Rust-Oleum.
 - c. Cascade Coatings.
- B. Danish Oil: Solvent-based, oil-type, penetrating stain for application by brush or wiping on interior wood surfaces.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Rust-Oleum/Watco
 - b. Rustins.
 - c. Cascade Coatings.

2.5 TRANSPARENT FINISHES

- A. Varnish, Interior, Water Based, Clear, Satin: Water-based clear satin coating for interior wood trim, frames, doors, paneling and cabinetry.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Minwax.
 - b. Varathane.
 - c. Ronseal.
 2. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.

- B. Varnish, Interior, Water Based, Clear, Semigloss: Water-based clear semigloss coating for interior wood trim, frames, doors, paneling and cabinetry.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Minwax.
 - b. Varathane.
 - c. Ronseal.
 - 2. Gloss Level: Manufacturer's standard semigloss finish.

- C. Varnish, Interior, Water Based, Clear, High Gloss: Water-based clear high-gloss coating for interior wood trim, frames, doors, paneling and cabinetry.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Minwax.
 - b. Varathane.
 - c. Ronseal.
 - 2. Gloss Level: Manufacturer's standard gloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

- B. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.

3.2 PREPARATION

- A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

- B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood Substrates, Wood Trim, Architectural Woodwork, Doors, Windows, and Wood Board Paneling:
 - 1. Semitransparent Stain System:
 - a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
 - b. Topcoat: Stain, exterior, solvent based, semitransparent.
 - 2. Water-Based Varnish over Stain System:
 - a. Stain Coat: Stain, semitransparent, for interior wood.
 - b. First Intermediate Coat: Water-based varnish matching topcoat.
 - c. Second Intermediate Coat: Water-based varnish matching topcoat.
 - d. Topcoat: Varnish, water based, clear, gloss level to be determined by Architect.
 - 3. Water-Based Varnish System:
 - a. Prime Coat: Water-based varnish matching topcoat.
 - b. Intermediate Coat: Water-based varnish matching topcoat.
 - c. Topcoat: Varnish, water based, clear, gloss level to be determined by Architect.
 - 4. Danish Oil System:
 - a. Prime Coat: Danish oil matching topcoat.
 - b. Topcoat: Danish oil.
- B. Wood Substrates, Wood Paneling and Casework:
 - 1. Semitransparent Stain System:

- a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
 - b. Topcoat: Stain, exterior, solvent based, semitransparent.
2. Water-Based Varnish over Stain System:
- a. Stain Coat: Stain, semitransparent, for interior wood.
 - b. First Intermediate Coat: Water-based varnish matching topcoat.
 - c. Second Intermediate Coat: Water-based varnish matching topcoat.
 - d. Topcoat: Varnish, water based, clear, gloss level to be determined by Architect.
3. Water-Based Varnish System:
- a. Prime Coat: Water-based varnish matching topcoat.
 - b. Intermediate Coat: Water-based varnish matching topcoat.
 - c. Topcoat: Varnish, water based, clear, gloss level to be determined by Architect.
4. Danish Oil System:
- a. Prime Coat: Danish oil matching topcoat.
 - b. Topcoat: Danish oil.

END OF SECTION 099300

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Phenolic-core toilet compartments.

1.2 ACTION SUBMITTALS

- A. Product data.
- B. Shop Drawings:
 - 1. Plans, elevations, sections, details, and attachment details.
- C. Samples: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
 - 1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf (1112 N) applied at any direction and at any point, without deformation of panel.
- C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Manufacturers
 - 1. Bradley
 - 2. General Partitions
 - 3. ASI
- B. Toilet-Enclosure Style: Overhead braced.
- C. Entrance-Screen Style: Overhead braced.
- D. Urinal-Screen Style: Wall hung.
- E. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.
- F. Entrance-Screen Construction: Matching panel construction.
- G. Urinal-Screen Construction: Matching panel construction.
- H. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- I. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- J. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.
- K. Phenolic Compartment Finish:
 - 1. Through-Color Phenolic: Manufacturer's standard solid through-color.
 - a. Color: As selected by Architect from manufacturer's full range.

2.3 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories. Mount with through bolts.
 - 1. Hinges: Manufacturer's stainless steel, surface-mounted, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees allowing emergency access by lifting door.
 - 2. Latch and Keeper: Manufacturer's standard stainless steel, surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.

3. Coat Hook: Manufacturer's standard stainless steel combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
 4. Door Bumper: Manufacturer's standard stainless steel, rubber-tipped bumper at outswinging doors.
 5. Door Pull: Manufacturer's standard stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221 (ASTM B221M).
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard toilet enclosures and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
1. Maximum Clearances:
 - a. Pilasters and Panels or Screens: 1/2 inch (13 mm).
 - b. Panels or Screens and Walls: 1 inch (25 mm).
 2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

SECTION 102600 - WALL AND DOOR PROTECTION

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. Corner guards.
 - 2. Wall Protection
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.
 - 2. Drawing Series I-001 "Color and Finish Legend" for basis-of-design selections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
 - 2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
 - 1. Corner Guards: 12 inches (300 mm) long. Include example top caps.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of exposed plastic material.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- (1200-mm-) long units.
 - 2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 QUALITY ASSURANCE

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).
 - a. Store corner-guard covers in a vertical position.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 CORNER GUARDS (CG1)

- A. Surface-Mounted, Aluminum corner guards.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Inpro Corporation Surface Mount Aluminum Corner Guard** or comparable product by one of the following:
 - a. CS Acrovyn
 - b. Pawling Systems
 - c. CR Lawrence
 - d. Koroseal Interior Products
 2. Wing Size: Nominal 1-1/2 inch by 1-1/2 inch.
 3. Mounting: Adhesive tape.
 4. Color and Texture: As selected by Architect from manufacturer's full range.

2.4 RIGID PVC SHEET WALLCOVERINGS (WP1)

- A. Semi-rigid, homogenous PVC panel containing no plasticizers or fillers.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product **Inpro Palladium Rigid Sheet Wall Protection** or comparable product by one of the following:
 - a. CS Acrovyn
 - b. Pawling Systems

- c. CR Lawrence
- d. Koroseal Interior Products
2. Size: 48 inches by 120 inches for sheet.
3. Sheet Thickness: 0.060 inch (1.5 mm).
4. Color and Texture: Smooth, Color as selected by Architect from manufacturer's full range, see I-001 "COLOR AND FINISH LEGEND" for basis-of-design selections.
5. Height: As indicated on drawings.
6. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
7. Mounting: Adhesive.

2.5 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. (800 J/m) of notch when tested according to ASTM D 256, Test Method A.
- C. Adhesive: As recommended by protection product manufacturer.

2.6 FABRICATION

- A. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- B. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.7 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm) apart.
 - 3. Adjust top caps as required to ensure tight seams.
- C. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.
- D. Door-Frame Protectors: Install on both door jams.
- E. Fire Doors: Install protection according to the listing of each item.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
1. Nystrom
 2. Larsens
 3. Babcock Davis

- B. Cabinet Construction: Fire Rating as required by location.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from **0.043-inch- (1.09-mm-)** thick cold-rolled steel sheet lined with minimum **5/8-inch- (16-mm-)** thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
 - 1. Square-Edge Trim: **1-1/4- to 1-1/2-inch (32- to 38-mm)** backbend depth.
- E. Cabinet Trim Material: Steel sheet
- F. Door Material: Steel sheet
- G. Door Style: Center glass panel with frame
- H. Door Glazing: Acrylic sheet
 - 1. Acrylic Sheet Color:
 - 2. Clear transparent acrylic sheet.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify fire extinguisher in fire-protection cabinet with the words FIRE EXTINGUISHER
 - 1) Location: Applied to cabinet door
 - 2) Application Process: Decals
 - 3) Lettering Color: Red
 - 4) Orientation: Vertical
 - 4. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by batteries
- K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Color: As selected by Architect from manufacturer's full range
2. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
 - 1. Nystrom
 - 2. Larsens
 - 3. Babcock Davis
 - a. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B[, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging].
- B. Multipurpose Dry-Chemical Type A, B, C: UL-rated 10lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416

SECTION 122413 - ROLLER WINDOW SHADES

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. Manually operated roller shades with single rollers.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
 - 2. Drawing Series I-001 "COLOR AND FINISH LEGEND" for owner approved basis-of-design selections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

- 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

- C. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.

- D. Samples for Initial Selection: For each type and color of shadeband material.

- 1. Include Samples of accessories involving color selection.

- E. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches (250 mm) square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches (400 mm) wide by 36 inches (900 mm) long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.

F. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material.
- C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in 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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS (WT1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide **Draper Industries, Blue Shade Architectural CM Manual Clutch Roller Shade** or a comparable product by one of the following:
 - 1. Draper, Inc.
 - 2. Mecho Systems
 - 3. Legrand
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and heavy duty architectural clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Stainless steel.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.
 - 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

- a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: varies, coordinate with field conditions.
 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
1. Shadeband Material: Light-filtering fabric.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: refer to Drawing Series I-001 "Color and Finish Legend" for owner approved finishes.
- G. Installation Accessories:
1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches (76 mm).
 2. Endcap Covers: To cover exposed endcaps.
 3. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
 4. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
 5. Installation Accessories Color and Finish: As selected from manufacturer's full range of standard and custom colors.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Source: Mermet Sun Control Textiles.
 2. Type: Woven PVC-coated fiberglass and PVC-coated polyester.
 3. Basis-of-Design: E Screen 3%
 4. Weave: Basketweave.
 5. Thickness: .020 inches (0.52 mm).
 6. Weight: 13.3 oz./sq. yd. (452 g/sq. m).
 7. Roll Width: 78 inches (200 cm), 98 inches (250 cm) or 122 inches (310 cm).
 8. Orientation on Shadeband: Railroaded.
 9. Openness Factor: 3 percent.
- B. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- C. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
 2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- D. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
 3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 142600 - LIMITED-USE/LIMITED-APPLICATION ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Limited-use/limited-application elevators.

1.2 ACTION SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal equipment.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Indicate loads imposed on building structure at points of support and power requirements.

C. Samples: For finishes involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator being provided.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction, for normal, unrestricted elevator use.

- C. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard maintenance agreement for a period matching the warranty duration, starting on date initial maintenance service is concluded.

1.5 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cibes Symmetry (**Basis of Design**)
- B. Garaventa Lifts
- C. Savaria

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with requirements for LU/LA elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system to withstand the effects of earthquake motions determined according to ASCE/SEI 7 and comply with elevator seismic requirements in ASME A17.1/CSA B44.
 - 1. Project Seismic Design Category: B Coordinate with structural drawings.
 - 2. Elevator Component Importance Factor: 1.0 Coordinate with structural drawings.
 - 3. Design earthquake spectral response acceleration short period (Sds) for Project is .167g. Coordinate with structural drawings.

2.3 SYSTEMS AND COMPONENTS

- A. Elevator System, General: Manufacturer's standard LU/LA elevator. Unless otherwise indicated, manufacturers' standard components are to be used, as included in standard LU/LA elevators and as required for complete system.
 - 1. Rated Load: 1000lb
 - 2. Rated Speed: 25 to 30 fpm (0.13 to 0.15 m/s).
- B. Machine Type: Hydraulic, holeless, beside the car; direct-acting hydraulic or roped hydraulic.

- C. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
 - 1. Pump to be submersible type inside oil tank from vibration isolation mounts.
 - 2. Motor to have solid-state starting.
 - 3. System to have hydraulic silencer and flexible piping connectors at pump unit.
- D. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

2.4 OPERATION SYSTEMS

- A. Provide manufacturer's standard operation system for selective-collective automatic operation.
- B. Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its car and hoistway doors, and shuts down. System includes rechargeable battery and automatic recharging system.
- C. Provide automatic operation of lights and ventilation fans.
- D. Emergency Operation: As required by jurisdiction having authority.

2.5 CAR ENCLOSURES

- A. Provide steel-framed car enclosures with wall panels, car roof, access doors, power door operators, and ventilation. Provide finished car including materials and finishes specified below.
- B. Clear Inside Dimensions:
 - 1. Inside Width: 42 inches (1065 mm) from sidewall to sidewall.
 - 2. Inside Depth: 60 inches (1524 mm) from back wall to front wall (return panels).
 - 3. Inside Height: 84 inches (2134 mm) to underside of ceiling.
- C. Materials and Finishes: Manufacturer's standards, but not less than the following:
 - 1. Floor Finish:
 - a. Elevator manufacturer's standard level-loop nylon carpet; color as selected by Architect from manufacturer's full range.
 - 2. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to manufacturer's standard core with manufacturer's standard protective edge trim. Panels to have a flame-spread index of 25 or less, when tested in accordance with ASTM E84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range.
 - 3. Metal Ceiling: Flush panels, fabricated from cold-rolled steel sheet. Provide panels with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.

4. Lighting: Not less than two downlights. Provide battery backup power source with automatic charging.
 - a. Light Fixture Efficiency: Not less than 35 lumens/watt.
 5. Handrail: Manufacturer's standard.
- D. Car Doors: Manufacturer's standard units complete with track systems, hardware, sills, and accessories.
1. Operation: Power-operated, automatic.
 2. Type: Horizontally operated, folding
 3. Clear Opening Width: 32 inches (815 mm).
 4. Door Height: 80 inches (2032 mm).
 5. Enameled or Powder-Coated Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.

2.6 HOISTWAY ENTRANCES

- A. Provide manufacturer's standard door-and-frame hoistway entrances, same size as car doors, complete with track systems, hardware, sills, and accessories.
1. Operation: Power-operated, automatic
 2. Type: Side hinged
- B. Coordinate frame size and profile with hoistway wall construction.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
1. Primed-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, corrosion-resistant primer or powder-coating for field painting.
- D. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies to comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as-close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
1. Fire-Protection Rating: 1-1/2 hours with 30-minute temperature rise of 450 deg F (250 deg C).

2.7 SIGNAL EQUIPMENT

- A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with light-emitting diodes.
1. Finish: Satin stainless steel, ASTM A480/A480M, No. 4 finish

- B. Car-Control Stations: Provide manufacturer's standard car-control stations. Mount in side panel adjacent to car door unless otherwise indicated.
 - 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Car Position Indicator: Provide digital-type position indicator in elevator car. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- E. Hall Push-Button Stations: Wall-mounted or jamb-mounted units equipped with buttons for calling elevator and for indicating desired direction of travel where applicable.
- F. Hall Lanterns: Wall-mounted or jamb-mounted units with illuminated arrows; but provide single arrow at terminal landings.
- G. Hall Annunciator: Provide audible signals indicating car arrival and direction of travel.
- H. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.8 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
- D. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063.
- E. Plastic Laminate: High-pressure type complying with ISO 4586-3, Type HGS for flat applications and Type BKV for panel backing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cylinder plumb and accurately located for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- B. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise from elevator system.
- C. Lubricate operating parts of systems as recommended by manufacturers.
- D. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Reduce clearances to minimum, safe, workable dimension at each landing.
- E. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and direction of travel.
- F. Set sills flush with finished floor surface at landing.
- G. Locate hall lanterns either above or beside hoistway entrance at a minimum of 72 inches (1829 mm) above finished floor unless hall lanterns are built into entrance frames.

3.2 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use, perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by authorities having jurisdiction.

3.3 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service to include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.

END OF SECTION 142600

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sleeves
 2. Sleeve-seal systems.
 3. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Designed to form a hydrostatic seal of 20 psig minimum.
 2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 3. Pressure Plates: Carbon steel or Stainless steel
 4. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 corrosion-resistant coating of length required to secure pressure plates to sealing elements.
 5. Make: "Link-Seal" Series 200,300 or 400.

2.3 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls..
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Using grout seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall. Secure nailing flanges to concrete forms.
- C. Using grout, seal space around outside of sleeves.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections. Repair leaks and retest until no leaks exist.
- B. Prepare test and inspection reports.

3.5 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior concrete walls above and below grade, Concrete slabs-on-grade and above grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

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END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.

- b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece stamped steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-Piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 210518

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Butterfly valves with indicators.
2. Check valves.
3. OS&Y gate valves.
4. Trim and drain valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory."
- B. FM Global Approved: Valves shall be listed in its "Approval Guide."
- C. ASME Compliance:
1. ASME B1.20.1 for threads for threaded-end valves.
 2. ASME B16.1 for flanges on iron valves.
 3. ASME B31.9 for building services piping valves.
- D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- E. NFPA Compliance for valves:
1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.
- F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.

- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.3 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating: 175 psig.
- B. Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Kennedy Valve; a division of McWane, Inc.
 - d. Milwaukee Valve Company.
 - e. Mueller Co.; Water Products Division.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Tyco Fire & Building Products LP.
 - h. Victaulic Company.
 - i. Viking Corporation.
 - 2. Standard: UL 312.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.
 - 7. Basis of Design Manufacturer: Victaulic Company Model 717 or Engineer approved equal.
- C. Bronze OS&Y Gate Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.

2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.
6. Basis of Design Manufacturer: Nibco Model T-104-0 or Engineer approved equal.

D. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. Hammond Valve.
 - g. Milwaukee Valve Company.
 - h. Mueller Co.; Water Products Division.
 - i. NIBCO INC.
 - j. Shurjoint Piping Products.
 - k. Tyco Fire & Building Products LP.
 - l. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.
6. Basis of Design Manufacturer: Nibco Model F-607-RW or Engineer approved equal.

E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Shurjoint Piping Products.
 - f. Tyco Fire & Building Products LP.
 - g. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 inches and Smaller:
 - a. Valve Type: Ball.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.

5. Valves NPS 2-1/2 inches and Larger:
 - a. Valve Type: Butterfly with integral wired tamper switches.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac prewired, single-circuit, supervisory switch indicating device.
7. Basis of Design Manufacturer: Victaulic Model 705w or Engineer approved equal.

2.4 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. Flowserve.
 - f. Kennedy Valve; a division of McWane, Inc.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Potter Roemer.
 - j. Tyco Fire & Building Products LP.
 - k. Victaulic Company.
 - l. Watts Water Technologies, Inc.
2. Basis of Design Manufacturer: Nibco Model KT-585-70-UL or Engineer approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with all Division 21 Sections for specific valve-installation requirements and applications.

- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.
- C. Install double-check valve assembly in each fire-protection water-supply connection.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523

SECTION 210524 - BACKFLOW PREVENTERS

PART 1 GENERAL

1.1 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's catalog sheets, flow chart, specification, test kit and installation instructions for each type backflow preventer.
- B. Product Data: For each type of product indicated in this section and for the final O & M manuals.
- C. Product warranties for all products in this section.
- D. Operation and maintenance data for the final O & M Manuals.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with the State Department of Health Sanitary Code for Cross Connection Control, and the other standards listed in Part 2 of this section.
 - 2. Where conflicts occur between the referenced standards, the most stringent requirements shall apply.

1.3 MAINTENANCE

- A. Special Tools (as furnished or recommended by the backflow preventer manufacturer). Deliver to the Owner's Representative:
 - 1. Test Kit B: Sight tube, of required length, for testing backflow preventer for proper operation, and printed procedure for conducting test.

PART 2 PRODUCTS

2.1 BACKFLOW PREVENTERS

- A. Double Check Detector Assembly, conforming to ASSE Standard 1015, AWWA C-510, USC specifications manual for Cross Connection control, and listed as acceptable in the New York State Department of Health, Environmental Health manual.
 - 1. Performance: 175 psig, and 140 degrees F, maximum working conditions.
 - 2. Assembly: Butterfly valve with integral tamper switch on inlet side and butterfly valve with integral tamper switch on outlet side, and one test cock, all as furnished or recommended by the backflow preventer manufacturer.
- B. Basis of Design Manufacturer: Watts Regulator Company Model 757 DCDA, Acceptable Manufacturers: Apollo, Febco; Lawler.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide the Work of this section in accordance with the manufacturer's printed installation instructions. The backflow prevention device shall be provided in compliance with the written installation instructions and dimensions indicated on the plans and required by the New York State Health Department Cross Connection Control Manual written requirements to isolate the fire protection water supply from the Public water service. Refer to plans and details.

3.2 FIELD QUALITY CONTROL

- A. Operation Test: Test kit as specified under Part 1 of this section may be used. Conduct test in the presence of the Owner's Representative.
 - 1. DCDA Backflow Preventer: Test the device with the test kit in accordance with the manufacturer's test procedure.
- B. Re-testing: Repair or replace any device failing the operation test, and repeat the test.
- C. Provide written test and inspection reports on New York State Department of Health forms and for the final O & M Manuals.

END OF SECTION 210524

SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Thermal hanger-shield inserts.
3. Fastener systems.
4. Equipment supports.

1.2 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression 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. NFPA Compliance: Comply with NFPA 13.
- D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, 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.

2.4 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.5 MATERIALS

A. Carbon Steel: ASTM A1011/A1011M.

B. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

C. Stainless Steel: ASTM A240/A240M.

D. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 07 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- E. Install lateral bracing with pipe hangers and supports to prevent swaying.
- F. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- G. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for 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.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 6.
 - 2. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 6.
 - 3. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 6.
 - 4. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 6, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 6 with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 8. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 6 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- H. 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 6.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 6 if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Comply with NFPA requirements.
- J. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. C-Clamps (MSS Type 23): For structural shapes.
 - 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- K. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark.
 - f. Emedco.
 - g. Seton Identification Products.
 2. Material and Thickness: Brass, 0.032 inch thick, with predrilled or stamped holes for attachment hardware.
 3. Letter and Background Color: As indicated for specific application under Part 3.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger

lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark.
 - f. Emedco.
 - g. Seton Identification Products.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Warning Signs and Labels:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark.
 - f. Emedco.

- g. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving. 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. Pipe Labels:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Carlton Industries, LP.
 - d. Champion America.
 - e. Craftmark.
 - f. Emedco.
 - g. Seton Identification Products.
 - B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
 - C. Letter and Background Color: As indicated for specific application under Part 3.
 - D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
 - E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.
- E. Permanently fasten labels on each item of fire-suppression equipment.
- F. Sign and Label Colors:
 - 1. White letters on an ANSI Z535.1 safety-red background.
- G. Locate equipment labels where accessible and visible.
- H. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E and other applicable codes and standards.
- I. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit a view of concealed piping.

3. Within 3 ft of equipment items and other points of origination and termination.
 4. Spaced at maximum intervals of 20 ft. along each run. Reduce intervals to 10 ft in areas of congested piping and equipment.
- J. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- K. Fire-Suppression Pipe Label Color Schedule:
1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background

END OF SECTION 210553

SECTION 211119 – FIRE DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-department connections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 - PRODUCTS

2.1 FIRE-DEPARTMENT CONNECTIONS

A. Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. GMR International Equipment Corporation.
 - c. Guardian Fire Equipment, Inc.
 - d. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching the Local Fire-Department threads.
7. Cap: Knox locking type.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Determined by Local Fire Department requirements.
12. Outlet Location: Bottom.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR."
14. Finish: Rough brass or bronze.
15. Outlet Size: To interface with the Local Fire Department requirements.

16. Basis of Design Manufacturer: Potter Roemer 5795-5799 Series (Storz-type), 5710-5734 (Siamese-type) or approved equal.
17. Signage: 14" wide x 10" high Aluminum sign labeled "FIRE DEPARTMENT HOSE CONNECTION" with red letters and reflective white background. Basis of Design Manufacturer: Seton Products or Engineer approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall-type fire-department connections.
- B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and fittings.
2. Sprinkler piping specialties.
3. Specialty valves.
4. Sprinklers.
5. Manual control stations.
6. Pressure gauges.

1.2 SYSTEM DESCRIPTION

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For wet-pipe sprinkler systems.
1. Include plans, elevations, sections, and attachment details.
 2. Include diagrams for power, signal, and control wiring.
- C. Delegated Design Submittals: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Qualification Data: For qualified Installer.

- C. Design Data: Approved sprinkler piping working plans, prepared according to NFPA 13, including documented approval by authorities having jurisdiction, and including hydraulic calculations if applicable.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- E. Field quality-control reports.
- F. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Sprinkler system equipment, specialties, accessories, installation, and testing to comply with NFPA 13.
- C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.
 - 1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: 8/5/2021
 - b. Performed by: Niagara Falls Water Board
 - c. Location of Residual Fire Hydrant R: H5-157 Cleveland Ave
 - d. Location of Flow Fire Hydrant F: H5-156 Cleveland Ave
 - e. Static Pressure at Residual Fire Hydrant R: 62 psi.
 - f. Measured Flow at 20 PSI Fire Hydrant F: 1087 gpm.
 - g. Residual Pressure at Residual Fire Hydrant R: 56 psi.

2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 3. Sprinkler Occupancy Hazard Classifications:
 - a. Churches: Light Hazard.
 - b. Educational: Light Hazard.
 - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - d. General Storage Areas: Ordinary Hazard, Group 1.
 - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - f. Offices: Light Hazard.
 4. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500 sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over 1500 sq. ft. area.
 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 120 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- E. Obtain documented approval of sprinkler system design from authorities having jurisdiction.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40 Steel Pipe: black-steel pipe, ASTM A53/A53M, Type E or S, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 plain end.
- C. Steel Pipe Nipples: black steel pipe, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- D. Steel Couplings: Galvanized and uncoated steel, ASTM A865/A865M, threaded.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- H. Roll grooved joint, steel pipe appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
2. Pressure rating: 175 psig minimum.
3. Galvanized and uncoated, grooved end fittings for steel piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved end pipe couplings for steel piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.

B. Commercial Riser Assembly:

1. Basis-of-Design Product: Subject to compliance with requirements, provide a Reliable Model CR commercial riser assembly or comparable product by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for drain, electrical sprinkler alarm switch, pressure gauges.
5. Body Material: 250 psi working pressure, elastomer faced clapper, cast gray iron.
6. Size: As indicated on drawings.
7. End Connections: Grooved.
8. Gauges: (two), 300 psig.
9. Valves: (two) 3-way globe valves.
10. Drain: 2 inch angle valve and close nipple.
11. Approvals: UL Listed and FM approved.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 1/2.
6. End Connections: Threaded.
7. Basis of Design Manufacturer: Tyco Model AD-2 or Engineer approved equal.

2.4 AIR VENT

A. Automatic Air Vent Assembly:

1. Description: Automatic dual air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly.
2. Standard: UL listed or FM Global approved for use in wet-pipe fire sprinkler system.
3. Vents oxygen continuously from system.
4. Float valve to prevent water discharge.
5. Minimum Water Working Pressure Rating: 175 psig.

2.5 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.
9. Basis of Design Manufacturer: Victaulic or Engineer approved equal.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Flexible Sprinkler Hose Fittings:

1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175-psig minimum.
4. Size: Same as connected piping, for sprinkler.

2.6 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation.
 2. Reliable Automatic Sprinkler Co., Inc.
 3. Tyco Fire & Building Products LP.
 4. Victaulic Company.
 5. Viking Corporation.
- B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
 3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
 2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Quick Response" temperature classification rating unless otherwise indicated or required by application.
 3. Basis of Design Manufacturer: Reliable Model G5-56 and F1FR56 or Engineer approved equal.
- D. Dry flexible sidewalls and semi-recessed pendants:
- a. Quick Response
 - b. K-5.6
 - c. Basis of Design: Victaulic.
- E. Sprinkler Finishes:
1. Chrome plated.
 2. Bronze.
 3. Factory Painted.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Sidewall Mounting: White factory finish, two pieces, semi-recessed.
- G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.
4. Basis of Design Manufacturer: Reliable or Engineer approved equal.

2.7 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.
- B. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.8 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AMETEK; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Winters Instruments.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gauge Range: 0 to 300 psig minimum.
- E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.
 1. Basis of Design Manufacturer: Winters Model PFE or Engineer approved equal.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. 8-inch Electric Bell:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. System Sensor.
 - b. Tyco Fire & Building Products LP.
 - c. Viking Corporation.
 2. Type: Electrically operated. 120 volt.
 3. Alarm Gong: Cast aluminum with red-enamel factory finish.
 4. Size: 8-inch diameter.

5. Basis of Design Manufacturer: System Sensor Model SSV120-10 or Engineer approved equal.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. Basis of Design Manufacturer: System Sensor Model OSY2 or Engineer approved equal.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to building's interior water-distribution piping.

- B. Install shutoff valve with tamper switch, backflow preventer with tamper switches, pressure gauge, drain, and other accessories indicated at connection to water-service piping.

3.2 INSTALLATION OF PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal and install where they are not subject to freezing.
- M. Fill sprinkler system piping with water.

- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. 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 pipes, tubes, and fittings before assembly.
- D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- F. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

D. Air Vent:

1. Provide at least one air vent in each wet pipe sprinkler system in accordance with NFPA 13 requirements. Connect vent into top of fire sprinkler piping.
2. Provide dielectric union for dissimilar metals, ball or globe valve, and strainer upstream of automatic air vent.

3.5 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers for use in wet-type systems with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.
- D. Provide higher temperature sprinklers in heated mechanical rooms.

3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections, turn results over to owner/AHJ:
 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Coordinate with fire-alarm tests. Operate as required.
 6. Verify that equipment hose threads are same as local fire department equipment.

- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports on NFPA forms only.

3.8 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves; and sprinkler drain piping: Galvanized, schedule 40 steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:
 - 1. Schedule 40 black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 6 (DN 65 to DN 100), to Be One of the Following:
 - 1. Schedule 40 black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.10 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: **Pendent, recessed, flush, and concealed sprinklers as indicated.**
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Pendent, dry sprinklers and sidewall, dry sprinklers as indicated.
 - 5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. Residential Sprinklers: Dull chrome.
 5. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
- C. Provide additional sprinklers in all locations where the work of other trades obstructs sprinkler pattern development or obstructs water from reaching the hazard.
- D. Spare Sprinklers
1. Provide a minimum of six (6) spare sprinklers for each type and temperature rating of sprinkler that is used on this project.
 2. Provide a spare sprinkler head box(s) and locate on the wall adjacent to the system riser in the water service entrance room.
 3. Provide one each of the appropriate sprinkler wrench for each type of sprinkler used on the project.
 4. Provide an allowance for fifteen (15), additional sprinkler heads and 15 linear feet of 1-inch branch piping per head in bid price which may be required to comply with codes and for obstructions encountered because of ductwork and structural steel during construction.

END OF SECTION 211313

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sleeves.
 2. Sleeve-seal systems.
 3. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: Waterproof type, EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.
 3. Make: "Link-Seal" Series 200, 300 or 400.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. 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 for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior walls, below grade and above basement floors:
 - a. Piping Smaller than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Interior Partitions:
 - a. Piping Smaller than NPS 6: PVC-pipe sleeves.

END OF SECTION 220517

SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves
2. Balance valves
3. Check valves
4. Gas valves
5. Hose threaded drain valves
6. Thermostatic mixing valves

1.2 BASIS OF DESIGN

- A. General Duty Valves for Plumbing Piping listed in “Part 2 – Products” are basis-of-design products subject to compliance with design requirements; provide the product indicated or an approved listed equal.

1.3 SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with Lead-Free drinking water requirements, ANSI/NSF 61 and ANSI/NSF 372.
2. Submit dimensioned drawings, specifications and cut-sheets.

B. Quality Reports.

1. Provide a full written report of all adjusting and balancing performed on the domestic water distribution system. Results of the report shall be guaranteed. Contractor shall be subject to recall to site to verify report information prior to acceptance of report.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source and from single manufacturer.
- B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 3. ASME B16.18 for solder-joint connections.
 4. ASME B31.9 for building services piping valves.
 5. ASME B16.1 for flanges on iron valves.
- C. NSF Compliance: Lead-free, NSF 61 and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
 2. Handlever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
1. Include 2-inch stem extensions.
 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 3. Memory stops that are fully adjustable after insulation is applied.

2.2 VALVE MANUFACTURERS

- A. Valves listed in this section are basis-of-design products subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:
1. Apollo.
 2. Bell & Gosset.
 3. Hammond.
 4. Homestead.
 5. Milwaukee.
 6. Nibco.
 7. Nordstrom.
 8. Red valve corporation.
 9. Resun.
 10. Watts.

2.3 BRASS BALL VALVES

A. Description:

1. 2 inch and smaller: 2-Piece, Full Port, Lead-free, brass body with chrome-plated ball and stem, 600 psi WOG, 150 psi WSP, quarter-turn operation, threaded ends. Valve shall have separate handle nut and packing nut. Watts LFFBV-3C (threaded)

2.4 BALANCING VALVES

A. Lead-free, brass body with 304 type stainless steel ball, fitted with 1/4 inch NPT tapped drain port.

1. Valve shall have meter connections with internal seals, built-in check valves, memory stop feature with an integral pointer to register degree of valve opening, and port openings for connecting differential pressure meter.
2. Balance valves shall be balance to individual gpm ranges as indicated on the contract documents.
3. Threaded end valves only. Bell & Gossett Model CB-LF "Circuit Setter Plus"

2.5 CHECK VALVES

A. Swing type (horizontal positions only)

1. 2 inch and smaller: Lead-Free, Tee Pattern, Bronze body, cap and disc, Stainless steel, hanger pin and plug, 200 psi WOG. Threaded end connections only. Watts LFCV

B. Spring type (horizontal or vertical positions)

1. 2 inch and smaller: Lead-Free, Bronze body, PTFE disc, Stainless steel spring and stem, 250 psi WOG. Threaded end connections only. Nibco T-480-Y-LF

2.6 GAS VALVES

A. Description:

1. 2 inch and smaller: UL listed, CSA approved to 0.5 psig and 5 psig, brass body, 2-Piece, full port ball valve. Threaded end valves only for natural gas use. Watts FBV-3C
2. 2-1/2 inch and larger: UL listed, CSA approved, 200 psi WOG, Class 125 flange type, Cast iron lubricated plug valve with manual lever actuators. Homestead Figure 612.

2.7 HOSE THREADED DRAIN VALVES

A. Description:

1. Lead-free, 400 psi WOG, copper silicon alloy brass body and end adapter, 2-Piece full port ball valve, PTFE seat and stem packing, 3/4 inch hose end connection. Watts LFFBVS-3C-CC.

2.8 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Thermostatic Water Mixing Valve – (TMV):

1. ASSE Standard 1070, IAPMO and UPC listed. Lead-Free brass 4-port, “H” pattern body with integral check valves, integral screens and an adjustment nut with locking feature. Make: Watts LFUSG-B-M2.
2. Connections: Threaded union 3/8 inch inlets and outlet.
3. Tempered-Water Setting: 105 deg F.
4. Minimum Flow Rates: 0.25 gpm.
5. Minimum Supply Pressure: 30 psi.
6. Exposed: Surface mounted

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide access panels where necessary.
- C. Install swing check valve, between pump and shutoff valve, on each pump discharge.
- D. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- E. Provide isolation valves and unions or flanges on each side of balancing valves, check valves and pressure reducing valves.
- F. Install valves in horizontal piping with stem at or above center of pipe.
- G. Install valves in position to allow full stem movement.
- H. Install balancing valves in locations where they can easily be adjusted.
- I. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
 2. Install heat trap on hot water supply line ahead of connection to mixing valve.

3. Point of use mixing valves for hand washing stations shall be set to 105 Deg F and installed on the hot water supply of the fixture.
- J. Use caution and extreme care when soldering valve connections to prevent valve seat damage. Apply heat with the flame pointed away from the center of the valve body. Inspect all valves after soldering, tighten valve packing nut and make adjustments if required to ensure proper valve operation. Replace all damaged valves.
- K. Provide hose threaded drain valves at all low points, strainers, and equipment as called for.
- L. Underground Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.2 WATER SERVICE VALVE APPLICATIONS

- A. General Application: Use flanged-end valves for installation aboveground. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 3 and Larger: UL/FMG, cast iron, OS&Y rising stem.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves as indicated in the specifications and on the contract documents.
- B. Set field-adjustable flow set points of balancing valves as indicated on the contract documents.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves as indicated in the specifications and on the contract documents.

END OF SECTION 220523

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. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Provide for the support of plumbing piping in compliance with Chapter 3 of the Plumbing Code of New York State.

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.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 552, Type II cellular glass with 100-psig with minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.
- B. Adjustable Stanchion Pipe Supports: All welded steel construction, corrosion resistant, base plate with adjustable steel threaded rod. Basis of Design: Watts Regulator Model RK-W-STD or approved equal.

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-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. Provide powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Provide mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Provide hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- J. Provide building attachments within concrete slabs or attach to structural steel. 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.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. 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.
- M. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: 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. Provide 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. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1- inches or less.

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. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Provide carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Provide padded hangers for piping that is subject to scratching.
- H. Provide 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 6.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 6, 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 6, requiring clamp flexibility and up to 4 inches of insulation.

4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 6.
 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 6.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 6, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 6, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 6, from two rods if longitudinal movement caused by expansion and contraction might occur.
 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 6 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 6.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 6 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-joint 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. 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. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- O. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

- P. Provide pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Valve tags.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.
- B. Identification components shall be compliant with ASME A13.1.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: Black.
 3. Background Color: White.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: Typewritten for each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers

where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

D. Valve Tags for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. 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.
3. Fasteners: Stainless-steel rivets or cable.
4. Basis of Design Manufacturer: Seton Style 300 or approved equal.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pre-tensioned Pipe Labels: Pre-coiled, semi rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Provide or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. Provide plastic equipment signs and labels at equipment items.
- D. Provide valve tags on all new valves installed in project. Provide a valve tag chart in the mechanical room hung 5'-0" above finished floor and in plastic sleeve.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, 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 20 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:

1. Domestic Cold Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

2. Domestic Hot Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3. Domestic Hot Water Recirculation Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

4. Sanitary Waste, Storm and Vent Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

5. Natural Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
1. Domestic cold, hot water and hot water recirculation piping.
 2. Sanitary waste piping exposed to freezing conditions.
 3. Roof drains and rainwater leaders.
 4. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 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 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.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping 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. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 FIELD-APPLIED JACKETS

- A. 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.

2.5 MAKES

- A. Fiberglass: Certainteed, Knauf, Johns Manville, Owens-Corning or approved equal.
- B. Adhesives: Childers, Foster Products, Tremco.

2.6 ADA SUPPLY AND DRAIN COVERS

- A. Truebro Lav Guard 2E-Z: ASME A112.18.9-2001, ADA article 4.19.4 (606.5) ADA compliant Antimicrobial Vinyl, China white, P-trap, supply line and valve covers.

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. 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. Cleanouts.

3.3 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.

3.4 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.5 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, of threaded fittings, of welded fittings, of threaded valves, and 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.

3.6 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Water: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: For domestic hot water and hot water recirculation piping, 1 inch thick on pipe sized 1-1/4 NPS and smaller, 1.5 inch thick on 1-1/2 NPS and larger.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: For domestic cold water piping, 1/2 inch thick on pipe sized 1-1/4 NPS and smaller. 1 inch thick on 1-1/2 NPS and larger.

- B. Stormwater and Overflow: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

- C. Roof Drain and Overflow Drain Bodies: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

- D. Sanitary piping exposed to freezing conditions: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.7 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. Piping Elbows and Tees:

1. PVC: 20 mils thick.

END OF SECTION 220719

SECTION 221000 – PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Copper tube and fittings.
3. Ductile-iron pipe and fittings.
4. Steel pipe and fittings.
5. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. System purging and disinfecting activities report.

1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Soil, Waste, Storm and Vent Piping: A minimum of 10-foot head of water.
 2. Domestic water piping: 50 psi greater than operating pressure or at the least 125 psi.
 3. Natural gas piping: 25 psi minimum unless otherwise indicated.

2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- C. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.
- D. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- E. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- F. 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.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe: ASTM A 74, Service weight cast iron.
- B. Fittings: Service weight type with "push-on" type fittings with ASTM C 564 extra heavy neoprene gasket.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe: ASTM A 888 no-hub cast iron.
- B. Fittings: ASTM C 1540 cast iron no-hub pattern with stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Make: Charlotte Pipe, Clamp-All, Husky, Tyler "Widebody".
- D. Above Slab Applications only.

2.5 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper piping is prohibited for urinal waste.
- B. Copper Type L Tube (Above Slab Water): ASTM B 88, water tube, drawn temper.
- C. Copper Type K Tube (Below Slab Water Only): ASTM 88, water tube, annealed temper.

- D. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- E. Copper Pressure Fittings:
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.
- H. Copper Pressure-Seal-Joint Fittings:
 - 1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 - 2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.6 DUCTILE-IRON PIPE AND FITTINGS

- A. Ductile-Iron Pipe:
 - 1. AWWA C151/A21.51, for thickness Class 52.
 - 2. Fittings shall meet ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53.
 - 3. Pipe and fittings shall have cement mortar lining, ASA A21.4-90 (AWWA-C104-90). Pipe and fittings shall have a coating of coal tar pitch varnish on the outside.
 - 4. Joints shall be ANSI/AWWA C111/A21.11. Joint shall be a push-on type joint with a single groove and rubber gasket, or mechanical joint with gasket and follower gland. There shall be two bronze wedges supplied at each joint of pipe, gasket and lubricant.

2.7 STEEL 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. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Joint Compound and Tape: Suitable for natural gas.
- C. 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.

2.8 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 2. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
- B. Copper to Steel Pipe: Cast bronze copper to iron female or male adapter with shoulder for drainage piping only. Dielectric pipe fittings.
- C. Copper to Cast Iron Pipe: Cast bronze, cast iron to sweat adapter.
- D. Steel to Cast Iron Pipe: Manhoff fittings, Cast iron soil pipe connector with spigot and IPS male thread end.
- E. Appliance Flexible Connectors:
 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 4. Corrugated stainless-steel tubing with polymer coating.
 5. Operating-Pressure Rating: 0.5 psig.
 6. End Fittings: Zinc-coated steel.
 7. Threaded Ends: Comply with ASME B1.20.1.
 8. Maximum Length: 72 inches.
- F. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 1. Copper-alloy convenience outlet and matching plug connector.

2. Nitrile seals.
 3. Hand operated with automatic shutoff when disconnected.
 4. For indoor or outdoor applications.
 5. Adjustable, retractable restraining cable.
- G. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
- H. Dielectric Pipe Fittings:
1. Tensile strength, ASME B16.8, union 250 psi, or flange design, 175 psi, pressure rating, at 210 Deg F, threaded or solder joint, constructed to prevent gasket from squeezing into internal opening.
 2. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. 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 for firestopping specified in Section 078413 "Penetration Firestopping."

- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- H. Install piping to permit valve servicing.
- I. Install piping at indicated slopes.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install piping to allow application of insulation.
- M. Make changes in direction for storm, soil, waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste or storm piping in direction of flow is prohibited.
- N. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- O. Install storm soil, waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Storm, Sanitary and Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- P. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

- Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- R. Plumbing Specialties:
1. Install backwater valves in sanitary waste gravity-flow piping where plumbing fixtures are installed on a floor with a finished floor elevation below the elevation of the manhole cover of the next upstream manhole in the public sewer.
 - a. Comply with requirements for backwater valves specified in Section 223000 "Plumbing Equipment."
 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 223000 "Plumbing Equipment."
 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 223000 "Plumbing Equipment."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs.
 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for escutcheons specified in Section 223000 "Plumbing Equipment."
- W. Do not use natural-gas piping as grounding electrode.
- X. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- Y. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- Z. 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.

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- E. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- F. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. 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.
- I. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

- K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Storm and Waste Drainage Piping:
 - 1. Install transition couplings at joints of piping with small differences in OD's
- D. Provided Shielded non-pressure transition couplings

3.5 VALVE INSTALLATION

- A. Comply with requirements in Specification Section 220523 "General Duty Valves for Plumbing Piping" for general-duty valve installation requirements.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install hangers for cast-iron, steel or copper piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical runs of cast iron, steel or copper piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect storm, soil and waste piping to exterior piping. Use transition fitting to join dissimilar piping materials.
- C. Connect domestic water, waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect domestic water and waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect domestic water, storm, waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves in access box with cleanout cover flush with floor.
 - 6. Comply with requirements specified in Section 223000 "Plumbing Equipment."
 - 7. Equipment: Connect piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections 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.

3.8 IDENTIFICATION

- A. Identify exposed piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 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 couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 Use dielectric flanges or flange kits

3.10 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Plumbing Test Procedure: Test storm, waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 - d. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - e. Use U-tube or manometer inserted in trap of water closet to measure this pressure.

- f. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - g. Inspect plumbing fixture connections for gas and water leaks.
 - h. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - i. Prepare reports for tests and for corrective action required.
4. Plumbing Test Procedure: Domestic water piping.
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
5. Plumbing test procedure: Natural gas piping.
- a. Perform tests as required by local Utility Company. Tests shall be witnessed by Owner's representative and local Utility Company. Contractor shall pay all costs.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced natural gas piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject the piping to 25 psig pressure for two hours prior to final connections to gas fired equipment.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- 3.11 CLEANING AND PROTECTION
- A. Clean interior of piping. Remove dirt and debris as work progresses.
 - B. Protect piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by piping installation.
- E. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.

3.12 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

Service	Pipe Materials	Fittings	Connections
Water service	Type K copper	Wrought copper	No-lead solder
Domestic water interior/hot, cold and circulating.	Type L copper	Wrought copper	No-lead solder
Domestic water interior/hot, cold [Below Slab]	Type K copper, soft temper	Wrought Copper	No-lead solder
Sanitary, vent and storm [Below Slab]	Service weight cast iron soil pipe	Cast iron hub and spigot	Neoprene gasket compression type
Sanitary, vent and storm [Above Slab]	Service weight cast iron soil pipe or type DWV copper	Cast iron hub and spigot, No-hub or wrought copper; drainage pattern	Neoprene gasket compression type, no-hub neoprene gasket and stainless steel clamp assembly or no-lead solder
Indirect waste	Type DWV copper	Wrought copper	No-lead solder
Natural gas [exterior above grade]	Schedule 40, black steel	Butt welded	Welded SEE NOTE A.
Natural gas, gas vent (interior)	Schedule 40, black steel	NPS 2 and smaller malleable; NPS 2-1/2 and over butt welded	Threaded and welded
Sump Pump Discharge (non-sewage material)	Type DWV Copper	Wrought copper	No-lead solder

NOTE A: Exposed exterior natural gas: For steel pipe, one coat of alkyd primer and two coats of exterior acrylic latex gloss enamel. Color as selected by Owner or Architect. Apply paint in accordance with manufacturer's directions. Remove spilled and splattered paint from all surfaces.

END OF SECTION 221000

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes water-distribution piping and related components for the building water service.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
 - 2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only

after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Architect or Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Architect's or Owner's written permission.

1.7 COORDINATION

- A. Coordinate connection to water main with utility company and pay all costs.

PART 2 - PRODUCTS

2.1 PIPING AND MATERIALS

- A. Refer to Section 221000 "Plumbing Piping" for piping materials.

2.2 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Zone Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts; a Watts Water Technologies company.
 - b. Wilkins.
 - c. Zurn Industries, LLC.
2. Watts Model NO.LF909; Lead-free, ASSE 1013 or AWWA C511 certified.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 9 psig maximum, through middle 1/3 of flow range.
5. Size: 2".
6. Design Flow Rate: 68 gpm.
7. Selected Unit Flow Range Limits: 78 gpm.
8. Pressure Loss at Design Flow Rate: 9 psig.
9. Body: Schedule 40 Stainless steel with interior lining complying with AWWA C550 or that is FDA approved.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories:
 - a. Valves: OS&Y with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 3 shall be soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- F. Underground Piping NPS 4 to NPS 8 shall be the following:
 - 1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.4 PIPING INSTALLATION

- A. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- B. Install ductile-iron piping according to AWWA C600 and AWWA M41.
- C. Bury piping with depth of cover with top at least 12 inches below level of maximum frost penetration.
- D. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

E. Mechanical sleeves and seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
3. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.6 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

3.7 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to interior domestic water piping.

3.8 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

- B. Hydrostatic Tests – Domestic Water: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.9 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.10 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Drain Pumps

1.2 ACTION SUBMITTALS

A. Product data.

B. Product Data Submittals:

1. Construction details, material descriptions, dimensions of individual components and profiles.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings:

1. Plans, elevations, sections, and attachment details.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Indicate actual installed items by marking submittals with an arrow or box.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with manufacturer's written instructions for handling.

1.5 WARRANTY

- A. **Manufacturer Warranty:** Manufacturer agrees to repair or replace sump pumps that fail in materials or workmanship within specified warranty period.
1. **Warranty Period:** 3 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. **UL Compliance:** Comply with UL 778 for motor-operated water pumps.

2.2 DRAIN PUMPS

- A. **Drain Pump – DP-1:**
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. Liberty Pumps
 - b. Zoeller Company
 - c. SFA Saniflo
 2. **Basis of Design:** Liberty Pumps Model 406.
 3. **Description:** Factory-assembled and -tested drain pump unit.
 4. Each drain pump shall be rated at 1/6 hp, 115 volts, 60 Hz, 3450 RPM. The unit shall produce 5 GPM at 25 feet of total dynamic head. The drain pump shall be capable of handling effluent with 1/8" solid handling capability. The drain pump shall have a max total dynamic head of 12 GPM @ 27 feet.
 5. The motor housing shall be constructed of ABS. All mating parts shall be sealed with a Buna-N O-ring or engineered gasket. All fasteners shall be stainless steel. The motor and switch shall be protected on the top side with an ABS access cover. The motor shall be protected on the lower side with both an engineered lip seal and two-piece carbon ceramic mechanical seal with stainless steel springs. The tank shall be made of ABS.
 6. The drain pump shall be supplied with 9 feet of multi-conductor power cord. The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code.
 7. All motors shall be air-filled and class B insulated NEMA B design, rated for continuous duty. At maximum load, the winding temperature shall not exceed 130°C un-submerged. The pump motor shall have an integral thermal overload switch in the windings for protecting the motor. The capacitor circuit shall be mounted internally in the pump.

8. Upper and lower ball bearings shall be required. The bearings shall be a single ball/race type bearing. Both bearings shall be permanently lubricated by grease. The motor shaft shall be made of stainless steel and have a minimum diameter of 0.175”.
9. The pump shall have an engineered lip seal with stainless steel springs and a secondary mechanical carbon ceramic seal. The motor plate/housing interface shall be sealed with a Buna-N O-ring.
10. The impeller shall be molded engineered polymer. It shall be threaded to the motor shaft.
11. All units are supplied with a CSA and UL approved automatic vertical float switch. The switch shall be mounted under the access cover and accessible for easy serviceability.
12. The ABS tank shall be a freestanding unit.
13. Components required for the repair of the pump shall be shipped within a period of 24 hours.
14. The pump shall have a ground continuity check and the motor chamber shall be hi-potted to test for electrical integrity, moisture content and insulation defects. The tank shall be pressurized, and an air leak decay test performed to ensure integrity of the tank seal. The pump shall be run, voltage current monitored, and checked for noise or other malfunction.
15. The pump shall be manufactured in an ISO 9001 certified facility.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 PIPING CONNECTIONS

- A. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.3 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.

3.4 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and inspections:
 - 1. Perform each visual and mechanical inspection.
 - 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.
 - 5. Pumps and controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

SECTION 223000 – PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Strainers
2. Water hammer arrestors
3. Trap seal devices
4. Floor drains
5. Roof drains
6. Cleanouts
7. Escutcheons
8. Meters and gauges
9. Downspout nozzles
10. Vertical expansion joints
11. Vent caps

1.2 BASIS OF DESIGN

- A. Plumbing Equipment listed in “Part 2 – Products” are basis-of-design products subject to compliance with design requirements; provide the product indicated or an approved listed equal.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Field quality-control reports.
- C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable-water piping and components shall comply with Lead-free, NSF 61 Annex G and NSF 14.
- B. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 STRAINERS FOR DOMESTIC WATER PIPING

- A. Wye-Pattern Strainers:

1. Watts LF777SI; Lead-free, 125 psig minimum, with bronze body, tapped retainer cap and drain closure plug, 304 type stainless steel screen.
2. Acceptable makes: Watts, Jay r. Smith, Josam, Precision Plumbing Products or Zurn.

2.4 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters – (WHA)

1. Watts LF15M2; Lead-free, threaded brass, PDI-WH 201 and ASSE 1010 certified, Copper body, 150 psi working pressure.
2. P.D.I. ratings based on water supply fixture units:
 - a. Type A – 1 thru 11 fixture units.
 - b. Type B – 12 thru 32 fixture units.
 - c. Type C – 33 thru 60 fixture units
 - d. Type D – 61 thru 113 fixture units.
 - e. Type E – 114 thru 154 fixture units.
 - f. Type F – 155 thru 330 fixture units.
3. Acceptable makes: Jay r. Smith, Josam, Precision Plumbing Products or Zurn.

2.5 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device – (TP):

1. Precision Plumbing Products Model PR-500; ASSE 1018 approved, 125 psi pressure rated, automatic pressure drop activated, brass body, 1/2-inch NPT inlet and FNPT outlet.
2. Provide additional distribution units as required for multiple traps.
3. Acceptable makes: Jay R. Smith, Mifab, Sioux Chief or approved equal.

2.6 FLOOR DRAINS

- A. Square type Floor Drain – (FD-1)

1. Zurn Model ZN-415-6S-VP; 6x6 inch square strainer made of polished nickel bronze, coated cast iron body, bottom outlet, vandal resistant with collar, flashing clamp and drain weepholes.

2. Acceptable makes: Jay R. Smith, Mifab, Watts or approved equal.

2.7 CLEANOUTS

A. Floor Cleanout – (DPCO)

1. Zurn “Level-Trol” Model ZN-1400-BP-KC; adjustable, dura-coated cast iron body with gas and watertight ABS tapered thread plug and round polished nickel bronze cover top adjustable to floor finish., vandal resistant with anchor flange, clamping collar and bronze plug.
2. Acceptable makes: Jay R. Smith, Mifab, Watts or approved equal.

B. Wall Plate Cleanout – (WPCO)

1. Horizontal type: Zurn Model Z-1441-BP-VP; vandal resistant, dura-coated cast iron body with gas and watertight ABS tapered thread plug and round smooth stainless steel access cover with securing screw.
2. Vertical type: Zurn Model Z-1468-BP-VP; vandal resistant, dura-coated cast iron body with gas and watertight ABS tapered thread plug and round smooth stainless steel access cover with securing screw.
3. Acceptable makes: Jay R. Smith, Mifab, Watts or approved equal.

2.8 ROOF DRAINS

A. Primary type Roof Drain – (RD-1)

1. Zurn Model ZA-100-C-R-VP; Bottom outlet, Dura-Coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette Aluminum Dome. Fitted with underdeck clamp, roof sump receiver and vandal proof locking dome.
2. Acceptable makes: Jay R. Smith, Mifab, Watts or approved equal.

B. Secondary type Roof Drain – (RD-2)

1. Zurn Model ZA-100-C-R-VP-W2; Bottom outlet with 2-inch high internal water dam, Dura-Coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette aluminum dome. Fitted with underdeck clamp, roof sump receiver, internal water dam and vandal proof locking dome.
2. Acceptable makes: Jay R. Smith, Mifab, Watts or approved equal.

2.9 DOWNSPOUT NOZZLES

A. Downspout Nozzles – (DSN)

1. Zurn Model ZANB199-SS; Downspout nozzle, all nickel bronze, with removable stainless steel screen.
2. Acceptable makes: Jay R. Smith, Mifab, Watts or approved equal.

2.10 VERTICAL EXPANSION JOINTS

A. Vertical Expansions Joints

1. Zurn Model ZRB190; Dura-coated cast iron body, packing gland and siliconed bronze sleeve with preformed neoprene packing gasket.
2. Acceptable makes: Jay R. Smith, Mifab, Watts or approved equal.

2.11 VENT CAPS

A. Vent caps for sanitary piping

1. Zurn Model Z-193; Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure vent pipe. Size to be same as that of vent stack being connected to.
2. Acceptable makes: Jay R. Smith, Mifab, Watts or approved equal.

2.12 THERMOMETERS

A. Thermometers for domestic water distribution piping

1. Weksler Model AS5H-9; 3-1/2 inch stem, 9-inch scale, brass well, swivel adjustment with 2 degree temperature scale integers and thermal well.
 - a. For domestic cold water piping: 0 to 160 degrees F range.
 - b. For domestic hot water piping: 30 to 240 degrees F range.
2. Acceptable makes: American, Ashcroft, Moeller, Weiss or approved equal.

2.13 PRESSURE GUAGES

A. Thermometers for domestic water distribution piping

1. Weksler Model EA14; 4-1/2 inch diameter dial with 0 to 160 psi range in 2 psi intervals, plastic lens and stainless steel class. Provide thermal well.
2. Acceptable makes: American, Ashcroft, Moeller, Weiss or approved equal.

2.14 ESCUTCHEONS

A. Pipe Escutcheons Covers Plates

1. Split hinge type, Cast-brass with polished chrome finish and set screw fastener. Provide chrome plated type escutcheons at all plumbing fixtures in finished areas.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Y-pattern strainers for water on supply side of each control valve water pressure-reducing valve solenoid valve and pump.
- B. Install water-hammer arresters in water piping according to PDI-WH 201.
- C. Install wall hydrants in accordance with manufacturers written instructions. Mount a minimum of 24-inches above grade.
- D. Install hose bibbs in accordance with manufacturers written instructions. Mount a minimum of 18-inches above grade.
- E. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- F. Install downspout nozzles for secondary roof drainage discharge piping. Install in accordance with manufacturers written instructions. Mount a minimum of 24-inches above grade.
- G. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- H. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- I. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- J. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- L. Install vent caps on each vent pipe passing through roof.
- M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance. Provide at roof drains that are located more than 25 feet above finished floor.
- N. Install flashing fittings and assemblies on sanitary stack vents and vent stacks that extend through roof.
- O. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- P. Install wall cleanouts in vertical conductors. Install access door in wall if required.
- Q. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- R. Install thermometers on all inlet and outlets of domestic water heating equipment or tempered supply water. Adjust faces of thermometers to proper angle for best visibility.
- S. Install pressure gauges upstream and downstream of incoming water service Adjust faces of gauges to proper angle for best visibility.
- T. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- U. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 223000

SECTION 223300 ELECTRIC, DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flow-Control, Electric, Tankless, Domestic-Water Heaters:

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 1. Warranty Periods: From date of Substantial Completion.
 - a. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
 - 1) Leaks: 5-year
 - 2) Parts: 1-year.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eemax, Inc.
 - b. Rheem Manufacturing Company
 - c. A.O. Smith Corporation
 - 2. Basis of Design: Eemax Model AM004120T.
 - 3. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
 - 4. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
 - a. Connections: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Heating Element: Resistance heating system.
 - d. Temperature Control: Flow-control fitting.
 - e. Safety Control: High-temperature-limit cutoff device or system.
 - f. Jacket: Aluminum or steel with enameled finish or plastic.
 - 5. Support: Bracket for wall mounting.
 - 6. Capacity and Characteristics:
 - a. Flow Rate: 0.3 gpm.
 - b. Maximum Temperature Setting: 105 deg F.
 - c. Power Demand: 3.5 kW.
 - d. Electrical Characteristics:
 - 1) Volts: 120 V.

- 2) Phases: Single.
- 3) Hertz: 60 Hz.
- 4) Amp Draw: 29 A.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Install in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping.
- B. Install thermometers on inlet and outlet piping of electric domestic-water heaters. Comply with requirements for thermometers specified in Division 22 specifications.
- C. Fill electric, domestic-water heaters with water.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 specifications. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial electric, domestic-water heaters.

END OF SECTION 223300

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gas-Fired, Tankless, Domestic Water Heaters
2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.

C. Product Certificates: For each type of commercial, gas-fired, domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

- 1. Warranty Periods: From date of Substantial Completion.

- a. Commercial, Finned-Tube, Gas-Fired, Domestic-Water Heaters:

- 1) Heat Exchanger: 15 years.
- 2) Controls and Other Components: 5 years.

- b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 GAS-FIRED, TANKLESS, DOMESTIC-WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Navien, Inc.
 - 2. Rheem Manufacturing Company

3. A.O. Smith Corporation
- B. Basis of Design: Navien Model NPE-240A2.
- C. Standard: ANSI Z21.10.3/CSA 4.3 for gas-fired, instantaneous, domestic-water heaters for indoor application.
- D. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
 1. Tappings: ASME B1.20.1 pipe thread.
 2. Pressure Rating: 150 psig.
 3. Heat Exchanger: Stainless steel.
 4. Insulation: Comply with ASHRAE/IES 90.1.
 5. Jacket: Metal, with enameled finish, or plastic.
 6. Burner: For use with tankless, domestic-water heaters and natural-gas fuel.
 7. Automatic Ignition: Manufacturer's proprietary system for automatic, gas ignition.
 8. Temperature Control: Adjustable thermostat.
- E. Support: Bracket for wall mounting.
- F. Capacity and Characteristics:
 1. Flow Rate: 5.6 at 67 deg F temperature rise.
 2. Temperature Setting: 125 deg F.
 3. Fuel Gas Demand: 199000 Btu/h.
 4. Fuel Gas Input: 199000 Btu/h.
 5. Gas Pressure Regulator:
 - a. Capacity: 199000 Btu/h.
 - b. Inlet Pressure: 3.5-10.5 in water column.
 6. Electrical Characteristics:
 - a. Volts: 120 V.
 - b. Phase: Single.
 - c. Hertz: 60 Hz.
 - d. Max Amperes: 4 A.
 7. Minimum Vent Diameter: 2 in.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks:
 1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 2. Construction:

- a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
3. Capacity and Characteristics:
- a. Working-Pressure Rating: 150 psig.
 - b. Capacity Acceptable: 5 gal. minimum.
 - c. Air Precharge Pressure: 50 psig.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 - General Duty Valves for Plumbing Piping.
1. Comply with requirements for balancing valves specified in Section 220523 - General Duty Valves for Plumbing Piping.
- F. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.
- G. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.
- H. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
- I. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
- J. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.
1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
- K. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

- L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Domestic-Water Heater Mounting: Install domestic-water heaters on domestic-water heater mounting bracket.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 - General Duty Valves for Plumbing Piping.
- C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
 - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 - 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.

4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 221000 - Plumbing Piping.
 - D. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
 - E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains.
 - F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220523 - General Duty Valves for Plumbing Piping.
 - G. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
 - H. Fill domestic-water heaters with water.
 - I. Charge domestic-water expansion tanks with air to required system pressure.
 - J. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.
 - K. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221000 - Plumbing Piping.
- B. Comply with requirements for gas piping specified in Section 221000 - Plumbing Piping.
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 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. Perform tests and inspections.

D. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION 223400

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water closets
2. Urinals
3. Lavatories
4. Mop Basins
5. Sinks
6. Electric Water Coolers

1.2 BASIS OF DESIGN

- A. Plumbing Fixtures listed in “Part 2 – Products” are basis-of-design products subject to compliance with design requirements; provide the product indicated or an approved listed equal.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit product data for all fixtures, trim and accessories prior to placing order for fixtures. Submit manufacturer’s color charts for fixture colors.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring if applicable.
- C. Submit cut out data for countertop fixtures to General Contractor.
- D. LEED Submittal: Include product data for credit WE 2, 3.1 and 3.2 documenting flow and water consumption requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operations and maintenance information for each fixture, faucet, shower and trim piece.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of faucets.
 - b. Servicing and adjustments of flush valves.

1.5 FIXTURE MAINTENANCE

- A. Provide owner with all special tools, wrenches or devices necessary for servicing plumbing fixtures and trim, as well as shower and faucet repair kits complete with all parts. Provide one (1) device for each five (5) fixtures installed, if there are less than five (5) devices installed provide a minimum of one (1) device.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. NSF Standard: Comply with NSF 61, NSF 62 and NSF 372, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 2. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 3. Vitreous-China Fixtures: ASME A112.19.2M.
 - 4. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
- F. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. NSF Potable-Water Materials: NSF 61, NSF 62 and NSF 372.
 - 2. Pipe Threads: ASME B1.20.1.
 - 3. Supply Fittings: ASME A112.18.1.
 - 4. Brass Waste Fittings: ASME A112.18.2.
- G. Comply with the following applicable standards and other requirements specified for shower and shower faucets:
 - 1. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 2. Faucets: ASME A112.18.1.
 - 3. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 - 4. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Brass and Copper Supplies: ASME A112.18.1.
 2. Manual-Operation Flushometers: ASSE 1037.
 3. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Grab Bars: ASTM F 446.
 2. Off-Floor Fixture Supports: ASME A112.6.1M.
 3. Plastic Toilet Seats: ANSI Z124.5.
 4. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 FIXTURE MAKES

- A. Fixtures listed in this section are basis-of-design products subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:
1. Water Closets, Urinals and Lavatories: American Standard, Crane, Eljer, Kohler, Mansfield, Sloan or Zurn.
 2. Water Closet Seats: American Standard, Bemis, Church, Kohler, Olsonite or Zurn.
 3. Flushometers: Delany, Delta, Sloan or Zurn.
 4. Fixture Carriers: Josam, Mifab, Jay R. Smith, Watts or Zurn.
 5. Faucets: Chicago, Delta, Moen, Symmons, Sloan or Zurn.
 6. Sinks: Elkay, Just, Kohler or Moen.
 7. Showers: Aker, Lasco, Universal or Swan.
 8. Shower Valves: Acorn, Bradley, Delta, Moen, Powers, Symmons or Speakman.
 9. Fixture Traps, Stops and Supplies: Central, Cambridge, McGuire, Wolverine or T&S Brass.
 10. Mop Basins: Fait, Kohler, Mustee or Stern-Williams.

2.2 WALL-MOUNTED, WATER CLOSETS

- A. Water Closets (WC-1):
1. American Standard Model No. 2234.015 "Madera"; ASME A112.19.2/CSA B45.1 and ASME A112.19.5 Compliant, Floor mounted, 1-1/2 inch top spud, vitreous china, siphon

jet, 1.28 gallons per flush, elongated type with fully glazed trap way, fitted with the following:

- a. Church Toilet Seat Model No. 9500SSC; white, solid plastic, open front with self-sustaining and external check holds/hinges less cover.
- b. Cast iron closet flange with stainless steel bolts and wax setting ring and China bolt caps.
- c. Sloan "Regal" Model 111-1.28 flush valve with screwdriver angle stop, quiet flush equipment, vacuum breaker, and seat bumper on angle stop.
- d. Height: Standard.

B. Water Closets (WC-2):

1. American Standard Model No. 3043.102 "Madera"; ASME A112.19.2/CSA B45.1 and ASME A112.19.5 Compliant, Floor mounted, 1-1/2 inch top spud, vitreous china, siphon jet, 1.28 gallons per flush, elongated type with fully glazed trap way, fitted with the following:

- a. Church Toilet Seat Model No. 9500SSC; white, solid plastic, open front with self-sustaining and external check holds/hinges less cover.
- b. Cast iron flange with stainless steel bolts and wax setting ring and China bolt caps.
- c. Sloan "Regal" Model 111-1.28 flush valve with screwdriver angle stop, quiet flush equipment, vacuum breaker, and seat bumper on angle stop.
- d. Height: Handicapped according to ICC A117.1. Install in compliance with all ADA required clearances and dimensions.

2.3 WALL-MOUNTED, URINALS

A. Urinals (UR-1):

1. American Standard Model No. 6590.001 "Washbrook"; ASME A112.19.2/CSA B45.1 and ASME A112.19.5 Compliant, Wall mounted, 3/4 inch top spud, 2 inch outlet, vitreous china, 0.5 gallons per flush, washout type with extended shields, fitted with the following:

- a. Jay R. Smith Series 637 urinal carrier with hanger pate and bottom bearing plate.
- b. Sloan "Royal" #186-0.5 flush valve with quiet flush equipment, vacuum breaker and screwdriver angle stop.
- c. Height: Standard

B. Urinals (UR-2):

1. American Standard Model No. 6590.001 "Washbrook"; ASME A112.19.2/CSA B45.1 and ASME A112.19.5 Compliant, Wall mounted, 3/4 inch top spud, 2 inch outlet, vitreous china, 0.5 gallons per flush, washout type with extended shields, fitted with the following:

- a. Jay R. Smith Series 637 urinal carrier with hanger pate and bottom bearing plate.

- b. Sloan "Royal" #186-0.5 flush valve with quiet flush equipment, vacuum breaker and screwdriver angle stop.
- c. Height: Handicapped according to ICC A117.1. Install in compliance with all ADA required clearances and dimensions.

2.4 DECK-MOUNTED, LAVATORIES

A. Lavatories (LAV-1):

1. American Standard Model No. 0330.000 "Townsend"; ASME A112.19.2/CSA B45.1 Compliant, Under-mounted, 19.5 x 14 inch, vitreous china, front overflow, self-draining deck, fitted with the following:
 - a. Sloan "Optima" Model No. EAF-250 battery powered sensor type deck mounted faucet. Single hole type with 4-inch center set cover plate, integrated side temperature mixer, with 0.5 gpm aerator.
 - b. McGuire Model No. LF167K; 3/8 inch chrome plated wall supplies with 12 inch flexible risers, cast brass set screw escutcheons and loose key angle stops.
 - c. McGuire Model No. 8902; 1-1/4 inch x 1-1/2 inch P trap, 17 gauge, chrome plated with cleanout plug and set screw escutcheon.
 - d. McGuire Model No. 155-WC; 1-1/4 inch tailpiece, 17 gauge, chrome plated P.O. plug with open grid strainer and offset.
 - e. Provide Truebro "Lav Guard" insulated coverings on waste and supply piping.
 - f. Provide ASSE 1070 water-temperature limiting device under fixture, set to 100 deg F.

2.5 WALL-MOUNTED, LAVATORIES

A. Lavatories (LAV-2):

1. American Standard Model No. 0355.012 "Lucerne"; ASME A112.19.2/CSA B45.1 Compliant, Wall mounted, 20 x 18 inch, 4 inch OC faucet holes, vitreous china, front overflow, self-draining deck with punchings for concealed arm carrier, fitted with the following:
 - a. Jay R. Smith Series 0700 concealed arm carrier, floor mounted type with welded base, locking device and leveling screw.
 - b. Sloan "Optima" Model No. EAF-250 battery powered sensor type deck mounted faucet. Single hole type with 4-inch center set cover plate, integrated side temperature mixer, with 0.5 gpm aerator.
 - c. McGuire Model No. LF167K; 3/8 inch chrome plated wall supplies with 12 inch flexible risers, cast brass set screw escutcheons and loose key angle stops.
 - d. McGuire Model No. 8902; 1-1/4 inch x 1-1/2 inch P trap, 17 gauge, chrome plated with cleanout plug and set screw escutcheon.
 - e. McGuire Model No. 155-WC; 1-1/4 inch tailpiece, 17 gauge, chrome plated P.O. plug with open grid strainer and offset.

- f. Height: Handicapped according to ICC A117.1. Install in compliance with all ADA required clearances and dimensions.
- g. Provide Truebro "Lav Guard" insulated coverings on waste and supply piping.
- h. Provide ASSE 1070 water-temperature limiting device under fixture, set to 100 deg F.

2.6 SINKS

A. Sink (SK-1):

- 1. Elkay Lustertone LRAD-171655. Counter mounted, stainless steel, 3-faucet holes, 18 gauge, self rimming, single bowl sink fitted with the following:
 - a. Chicago Model No. 786-E3 deck mounted faucet with gooseneck spout, wrist-blade handles and 1.5 GPM pressure compensation aerator.
 - b. McGuire #151A stainless steel strainer with removable cup, 1-1/2 inch tailpiece.
 - c. McGuire #8912 Semi-cast brass adjustable "P" trap, 1-1/2 inch x 1-1/2 inch, with cleanout plug.
 - d. McGuire #LF2167 1/2 inch supplies with 3/8 inch flexible risers, loose key stops and metal, chrome plated escutcheons.
 - e. Provide ASSE 1070 water-temperature limiting device under fixture, set to 100 deg F.

2.7 FLOOR-MOUNTED MOP BASINS

A. Mop Basins (MSB-1):

- 1. Mustee Model No. 63; Fiberglass resin type floor mounted, 24 inch x 24 inch x 10 inch deep mop basin, fitted with the following:
 - a. Mustee Model No. PN-65.6; Mop Hanger
 - b. Mustee Model No. PN-65.7; Hose and hose bracket
 - c. Mustee Model No. PN-63-401; Rigid vinyl bumper guards.
 - d. Brass drain assembly; 3 inch chrome plated brass drain body, lock-nut, neoprene sealing washers, flat strainer and stainless steel screws.
 - e. Chicago Faucets Model No. 897; service sink type faucet with vacuum breaker, adjustable stop arms, 3/4 inch hose thread outlet and pail hook.

2.8 WALL-MOUNTED, ELECTRIC WATER COOLERS

A. Electric Water Coolers (EWC-1):

- 1. Elkay Model Number LZSTL8WSLP lead free, self-closing electric water cooler, dual unit, each unit with one piece stainless steel basin and backsplash, flexible safety bubbler, non-pressurized tank, vandal-proof pushbars on front of each unit, mounting hangers, and electronic bottle filler.

- a. Jay R. Smith Series 0834 floor mounted carrier
- b. Height: ADA.
- c. Each Compressor: Hermetically sealed, 120V, 60 Hz, 5 FLA single phase compressors.
- d. Each Unit Capacity: 8.0 GPH at 80 deg F water inlet, 50 deg F water outlet with room temperature at 90 deg F.
- e. Provide lead-free trap and supply for each unit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixture will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung fixtures.
- C. Install accessible wall-mounted fixtures at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted fixtures in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink or lavatory faucet.
 1. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- G. Seal joints between fixtures and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks.
- I. Use carrier supports with waste-fitting assembly and seal.
- J. Use off-floor carriers with waste fitting and seal for back-outlet urinals.

- K. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
- L. Install trap-seal liquid in waterless urinals.
- M. Flushometer-Valve Installation:
 - 1. Install flushometer-valve, water-supply fitting on each supply to each water closet or urinal.
 - 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 - 3. Install lever-handle flushometer valves for accessible water closets or urinals with handle mounted on open side of water closet or urinal.
 - 4. Install actuators in locations that are easy for people with disabilities to reach.
 - 5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- N. Install toilet seats on water closets.
- O. Assemble shower components according to manufacturers' written instructions.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Set shower receptors in leveling bed of cement grout.

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, risers, traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water, soil and waste piping requirements.
- C. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at flushometer valves and faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

- A. After completing installation of fixtures, inspect and repair damaged finishes.
- B. Clean fixtures and fittings with manufacturers' recommended cleaning methods and materials.
- C. Install protective covering for installed fixtures and fittings.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

LaBella Associates, D.P.C.
Project No. 2221723

Academic Innovation Hub
Work Force Development Training
Niagara University

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END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Piping materials and installation instructions common to most piping systems.
- 2. Mechanical sleeve seals.
- 3. Sleeves.
- 4. Escutcheons.
- 5. Grout.
- 6. Equipment installation requirements common to equipment sections.
- 7. Painting and finishing.
- 8. Concrete bases.
- 9. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.

2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
1. Finish: Polished chrome-plated
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
1. Finish: Polished chrome-plated
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.5 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 according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - j. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.

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. 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 not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 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."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment. All wood grounds, nailers or blocking to be fire resistant.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 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. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - 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
 - c. Trerice, H. O. Co.
 - d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - e. Weiss Instruments, Inc.
 - f. WIKA Instrument Corporation - USA.
 - g. Winters Instruments - U.S.
2. Standard: ASME B40.200.
 3. Case: Cast aluminum; 9-inch nominal size.
 4. Case Form: Adjustable angle unless otherwise indicated.
 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 7. Window: Glass.
 8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
 9. Connector: 3/4 inch, with ASME B1.1 screw threads.
 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES 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.

2.3 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. Marsh Bellofram.
 - d. Tel-Tru Manufacturing Company.
 - e. Terice, H. O. Co.
 - f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - g. Weiss Instruments, Inc.
 - h. WIKA Instrument Corporation - USA.
 - i. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Sealed 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: Brass.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.4 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. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 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. Terice, 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.

2.6 TEST-PLUG KITS

- 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. Terrice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- D. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter 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.
- K. Install test plugs in piping tees.
- L. Install flow indicators in piping systems in accessible positions for easy viewing.
- M. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- N. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
- O. Install permanent indicators on walls or brackets in accessible and readable positions.
- P. Install connection fittings in accessible locations for attachment to portable indicators.
- Q. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
- R. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler.
 - 3. Inlet and outlet of each chiller.
 - 4. Inlet and outlet of each hydronic coil in air-handling units.
 - 5. Two inlets and two outlets of each hydronic heat exchanger.
 - 6. Inlet and outlet of each thermal-storage tank.
 - 7. Outside-, return-, supply-, and mixed-air ducts.
- S. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each boiler hot-water connection.
 - 3. Suction and discharge of each pump.

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 the following:
 - 1. Compact-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
 - 1. Compact-style, liquid-in-glass type.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 psi.
- B. Scale Range for Heating, Hot-Water Piping: 0 to 100 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. Brass ball valves.
- 2. Bronze ball valves.
- 3. High-performance butterfly valves.
- 4. Bronze swing check valves.
- 5. Iron swing check valves.
- 6. Iron, grooved-end swing-check valves.
- 7. Iron, center-guided check valves.
- 8. Radiator valves and union elbows
- 9. Self-contained 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.
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. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - d. Hammond Valve.
 - e. Jamesbury; a subsidiary of Metso Automation.
 - f. Kitz Corporation.
 - g. Marwin Valve; a division of Richards Industries.
 - h. Milwaukee Valve Company.
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: Forged brass.
 - f. Ends: Threaded.

- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - 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.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - c. Crane Co.; Crane Valve Group; Flowseal.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Process Development & Control, Inc.

- i. Tyco Valves & Controls; a unit of Tyco Flow Control.
2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Carbon steel.
 - h. Service: Bidirectional.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, 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.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.

- f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
2. Description:
- a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Composition.
 - h. Seat Ring: Bronze.
 - i. Disc Holder: Bronze.
 - j. Disc: PTFE or TFE.
 - k. Gasket: Asbestos free.

2.7 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Anvil International, Inc.
 - b. Shurjoint Piping Products.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.

2. Description:
 - a. CWP Rating: 300 psig.
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring operated, ductile iron or stainless steel.

2.8 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. APCO Willamette Valve and Primer Corporation.
 - c. Hammond Valve.
 - d. Metraflex, Inc.
 - e. Milwaukee Valve Company.
 - f. Mueller Steam Specialty; a division of SPX Corporation.
 - g. NIBCO INC.
 - h. Spence Strainers International; a division of CIRCOR International.
 - i. Sure Flow Equipment Inc.
 - j. Val-Matic Valve & Manufacturing Corp.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Compact wafer.
 - f. Seat: Bronze.

B. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.

2. Description:

- a. Standard: MSS SP-125.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. NPS 14 to NPS 24, CWP Rating: 150 psig.
- d. Body Material: ASTM A 126, gray iron.
- e. Style: Compact wafer.
- f. Seat: EPDM or NBR.

2.9 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, 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 or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.

- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.10 RADIATOR GLOBE VALVES AND UNION ELBOWS.

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve
 - b. Blue Fin
 - c. Legend
 - d. Milwaukee Valve Company.
 - e. Approved equivalent.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 250 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Inlets: FPT Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Composite.
 - h. Threaded NPT tailpiece with union.
 - i. Union elbows same material and configuration less valve.

2.11 RADIATOR GLOBE VALVES AND UNION ELBOWS.

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Danfoss RA-C series
 - b. Barnes and Jones
 - c. Honeywell
 - d. Approved equivalent.
2. Description:
 - a. Valves shall be available in sizes 1/2", 3/4", 1" and 1-1/4" (NPT) in straight, angle, reverse angle, and double patterns with double O-ring gland , union nut seat or threaded outlet tailpiece and female pipe thread inlets. Actuators shall be self-contained and shall be available in attached, remote bulb, wall and wall mounted with dual capillary styles. Actuators may have concealed set point/limit lock feature and set point memory disc. Optional thermostatic guards shall reinforce installation strength and prevent tampering.

- b. All valves shall have forged bronze bodies, brass or stainless steel trim, stainless steel stems and EPDM seals.
- c. Actuators shall have liquid filled elements with high impact white plastic covers.
- d. Max. Temp: 248° F
- e. Max. Static Pressure: 45 PSIG
- f. Max. Test Pressure: 232 PSIG
- g. Max. Differential Pressure (water): 8.7 PSIG
- h. Max. Sensor Temp: 140° F
- i. Adjustable Temp. Range: 45° - 86° 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

- 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 ball and butterfly 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. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

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, or butterfly valves.
 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 3. Throttling Service except Steam: butterfly or globe valves.
 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or iron, center-guided, 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 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 7. For Grooved-End Steel Piping: Valve ends may be grooved.

3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.
 3. Bronze Swing Check Valves: Class 125, bronze or nonmetallic disc.
 4. Bronze Globe Valves: Class 125, bronze or nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. High-Performance Butterfly Valves: Class 150, single flange or lug style.
3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and weight.
5. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 150, compact-wafer, resilient seat.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 125 nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. High-Performance Butterfly Valves: Class 150, single flange.
3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and weight.
5. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 125, compact-wafer, resilient seat.

3.7 RADIATOR VALVE SCHEDULE

A. For each cast iron radiation - Pipe NPS 2 and Smaller:

1. Self-Contained Temperature control valve on supply inlet with wall mounted control sensor and adjustment.
2. Union elbow or tailpiece on outlet

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. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

- B. Related Sections:

1. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
2. Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
3. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal 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. 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.

1.5 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. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 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.
- B. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass or polyurethane.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Manufacturers standard finish unless bare metal surfaces are indicated.

2.5 THERMAL-HANGER SHIELD INSERTS

- 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. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold and Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- 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.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 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-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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: 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. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. 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.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

- L. 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.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: 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.
 - 2. All field or shop fabricated steel piping supports/stands and equipment supports/stands as well as any steel fabricated pieces must be primed and painted.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. 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. 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.
 - 3. 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.
 - 4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 7. 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.
 - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 9. 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.
 - 10. 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.
- K. 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.

- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
- M. 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-joint 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. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 11. 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. Medium (MSS Type 32): 1500 lb.
- N. 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.
- O. 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 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.

4. 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.
5. 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.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Housed-spring isolators.
4. Housed-restrained-spring isolators.
5. Elastomeric hangers.
6. Spring hangers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each vibration isolation device.
 1. Include design calculations for selecting vibration isolators.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads.

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Ribbed or Waffle pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.

- b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig (3447 kPa)**.
 - b. Top housing with attachment and leveling bolt or threaded mounting holes and internal leveling device.

2.4 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
 1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig (3447 kPa)**.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 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.

2.5 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.6 SPRING HANGERS

- A. 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.

PART 3 - EXECUTION

3.1 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 230548.13

SECTION 230550 -WIND RESTRAINT FOR HVAC 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 SECTION INCLUDES

- A. Support and brace roof mounted mechanical and electrical systems, to resist directional wind forces (lateral, longitudinal, and vertical).

1.3 APPLICABLE CODES AND STANDARDS

- A. Provide work in compliance with the following codes and standards:
 - B. Building Code of New York State, Section 1613.
 - C. Mechanical Code of New York, Section 301.
 - D. American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures -Standard ASCE/SEI 7-05.

1.4 QUALITY ASSURANCE

- A. General:
 - 1. The contractor shall provide professional engineer stamped and signed calculations, and details of wind restraint systems to meet total design lateral force requirements for support and restraint of mechanical and electrical systems.
 - 2. Systems requiring wind restraint:
 - a. Refrigerant piping on roof.
 - b. New Roof mounted HVAC equipment.
 - c. Existing Roof mounted HVAC equipment removed and reinstalled to facilitate roofing replacement, where new curbs or equipment rails have been provided.

1.5 SUBMITTALS

- A. Submit wind force level (F_p) calculations from applicable building code. Submit pre-approved restraint selections, installation details, and plans indicating locations of restraints.
- B. Calculations, plans, restraint selection, and installation details shall be stamped and signed by a professionally licensed engineer experienced in wind restraint design.
- C. Submit manufacturer's product data.
- D. For each piece of equipment that requires wind restraint as outlined in this section, include the following:
 - 1. Dimensioned Outline Drawings of Equipment Unit: Identify the center of gravity and locate and describe mounting and anchoring provisions.
 - 2. Anchorage: Provide detailed description of equipment anchorage devices on which the calculations are based and their installation requirements. Identify anchor bolts, studs and other mounting devices. Provide information on the size, type and spacing of mounting brackets, holes and other provisions.

PART 2 -PRODUCTS

2.1 CODE INFORMATION

- A. This project is subject to the wind bracing requirements of the Building Code of New York State, International Building Code and American Society of Civil Engineers ASCE 7. The following criteria are applicable to this project:
 - 1. Basic Wind Speed (V) (Per ASCE 7-16): 117 mph.
 - 2. Importance Factor (I) (Per ASCE 7-16): 1.00.
 - 3. Exposure Category (Per ASCE 7-16): C
 - 4. Height and Exposure Adjustment Coefficient (Per ASCE 7-16).
 - 5. The mean height of the structure (h_{MEAN}) shall be determined thru coordination with Architectural plans and the General Contractor.

2.2 WIND BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
 - 1. Design analysis shall include calculated dead loads, wind loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 - 2. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.

3. All wind restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in Section 2.1.
- B. Friction from gravity loads shall not be considered resistance to wind forces.

PART 3 -EXECUTION

3.1 INSTALLATION

A. Wind Restraint of Piping:

1. All restraint systems shall be installed in strict accordance with the manufacturer's restraint guidelines and all certified data.
2. Installation of restraints shall not cause any change in position of equipment or piping, resulting in stresses or misalignment.
3. Transverse piping restraints shall be at 40-foot maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
4. Longitudinal restraints shall be at 80-foot maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
5. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24-inches of the elbow or tee or combined stresses are within allowable limits at longer distances.
6. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints.
7. Branch lines may not be used to restrain main lines.
8. Provide reinforced clevis bolts when required.
9. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent piping.
10. Do not brace a system to two independent structures such as roof and wall.

B. Wind Restraint of Electrical Services:

1. All restraint systems shall be installed in strict accordance with the manufacturer's restraint guidelines manual and all certified data.
2. Installation of restraints shall not cause any change in position of equipment or piping, resulting in stresses or misalignment.
3. No rigid connections between equipment and the building structure shall be made that

degrade the noise and vibration-isolation system specified.

4. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
5. Prior to installation, bring to the Architect's/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
6. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or wedge-type concrete anchors. Consult Structural Engineer of record.
7. Overstressing of the building structure shall not occur from overhead support of equipment. Bracing attached to structural members may present additional stresses. The Contractor shall submit loads to the structural engineer of record for approval in this event.
8. Brace support rods when necessary to accept compressive loads. Welding of compressive braces to the vertical support rods is not acceptable.
9. Provide reinforced clevis bolts where required.
10. Do not brace a system to two independent structures such as a roof and wall.

C. Wind Restraint of Equipment:

1. All restraint systems shall be installed in strict accordance with the manufacturer's restraint guidelines and all certified submittal data.
2. The interaction between mechanical and electrical equipment and the supporting structures shall be designed into the restraint systems.
3. Friction clips shall not be used for anchorage attachments.
4. Expansion anchors shall not be used for non-vibration isolated equipment rated over 10 HP.
5. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction and vertical restraints shall be provided to resist overturning.
6. Installation of restraints shall not cause any change in position of equipment or ductwork, resulting in stresses or misalignment.
7. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
8. Do not install any equipment or duct that makes rigid connections with the building unless isolation is not specified.
9. Prior to installation, bring to the Architect's/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
10. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or wedge-type concrete anchors. Consult Structural Engineer of record.

11. Overstressing of the building structure shall not occur from overhead support of equipment. Bracing attached to structural members may present additional stresses. The Contractor shall submit loads to the Structural Engineer of record for approval in this event.
12. Brace support rods when necessary to accept compressive loads. Welding of compressive braces to the vertical support rods is not acceptable.
13. Provide reinforced clevis bolts where required.
14. Do not brace a system to two independent structures such as a roof and wall.

END OF SECTION 230550

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. Pipe labels.
 - 3. Duct labels. (Mechanical Rooms and concealed locations only)
 - 4. Valve tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to be included in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Per ANSI 13.1 label standard.

2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. 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.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 1. Refrigerant Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 2. Heating Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 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 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; 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. Chilled Water: 1-1/2 inches, round.
 - b. Refrigerant: 1-1/2 inches, round.
 - c. Hot Water: 1-1/2 inches, round.

 - 2. Valve-Tag Color:
 - a. Chilled Water: Natural.
 - b. Refrigerant: Natural.
 - c. Hot Water: Natural.

 - 3. Letter Color:
 - a. Chilled Water: Black.
 - b. Refrigerant: Black.
 - c. Hot Water: Black.

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.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Primary-secondary hydronic systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB reports.
- C. 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.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT 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.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to 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. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in 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. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.

- c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check liquid level in expansion tank.
 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Section 232123 "Hydronic Pumps."
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
 - C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
 - D. Set calibrated balancing valves, if installed, at calculated presettings.
 - E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
 - F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
 - G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
 - H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
 - I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
 - J. Check settings and operation of each safety valve. Record settings.
- 3.8 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS
- A. Balance the primary circuit flow first and then balance the secondary circuits.
- 3.9 PROCEDURES FOR HEAT EXCHANGERS
- A. Measure water flow through all circuits.
 - B. Adjust water flow to within specified tolerances.
 - C. Measure inlet and outlet water temperatures.

- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.10 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. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.11 PROCEDURES FOR AIR-COOLED CONDENSERS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.

3.12 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

3.14 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent
 2. Air Outlets and Inlets: Plus or minus 10 percent
 3. Heating-Water Flow Rate: Plus or minus 10 percent
 4. Cooling-Water Flow Rate: Plus or minus 10 percent

3.15 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.

- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 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. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.

2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

E. Apparatus-Coil Test Reports:

1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft..
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.

- i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.
- F. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:

- a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft..
 - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- 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, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.

- e. Suction static pressure in inches wg.
- I. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
 - J. Air-Terminal-Device Reports:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft..
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
 - K. 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. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
- a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (Indicated and Actual Values):
- a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- M. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.17 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.

C. Prepare test and inspection reports.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. Outdoor, concealed supply and return.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.3 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 of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 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 "Duct Insulation Schedule, General," and "Indoor Duct and Plenum 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. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
 - 1. Products:
 - a. Apache Products Company; ISO-25.
 - b. Dow Chemical Company (The); Trymer.
 - c. Duna USA Inc.; Corafoam.
 - d. Elliott Company; Elfoam.
 - 2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
 - 3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches (38 mm) as tested by ASTM E 84.
 - 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 5. Factory-Applied Jacket: Requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 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. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.

- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. 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, but are not limited to, the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.

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, 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.
 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, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
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 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.Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. 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.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - f.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, 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-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - b. Vimasco Corporation; 713 and 714.
 - c.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 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.Eagle Bridges - Marathon Industries; 405.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - c. 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.
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."

2.7 FACTORY-APPLIED JACKETS

- ### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

- ### A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- ### B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.9 TAPES

- ### A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, 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.

B. 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.

2.10 SECUREMENTS

A. Bands:

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.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - 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.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 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.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. 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.
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.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

2.11 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.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

2.12 SELF-ADHESIVE, FIELD-APPLIED, OUTDOOR JACKETS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Polyguard Products, Inc.; Alumaguard Lite, or comparable product by one of the following:

1. 3M.
2. MFM Building Products Corp.

B. General Requirements for Self-Adhesive Outdoor Jacket: Laminated vapor barrier and waterproofing membrane with perm rating of 0.00 perm (0.00 metric perm), when tested according to ASTM E 96/E 96M, for installation over either fiberglass or foam board insulation located above ground outdoors; consists of a foil polymer laminated film with a coating of rubberized bituminous compound or acrylic adhesive that allows membrane to self-adhere to the substrate.

C. Alumaguard Lite: Multi-ply aluminum foil/polymer composite film coated with a low-temperature acrylic adhesive.

1. Stucco Embossed Silver Thickness: 9-mils (0.23-mm).
2. White Matte Cool Wrap Finish Thickness: 9-mils (0.23-mm).
 - a. Solar Reflectance, CRRC Initial Rating: 0.86.
 - b. Solar Reflectance, CRRC 3-Year Rating: 0.77.
 - c. Thermal Emittance, CRRC Initial Rating: 0.82.
 - d. Thermal Emittance, CRRC 3-Year Rating: 0.86.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. 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.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

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 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped

pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- 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 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After the adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Inspect ductwork, 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 duct system defined in the "Duct Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.
7. Exposed ductwork in occupied spaces without ceilings.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.0-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

B. Concealed, round, exhaust-air duct insulation (within 15 feet of the fan damper) shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.0-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

C. Concealed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.0-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

- D. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:
 - 1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- E. Concealed, outdoor-air plenum insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- F. Exposed, round combustion and outdoor-air duct insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- G. Exposed, rectangular, supply-air duct insulation shall be one of the following (in unoccupied spaces, corridors, vestibules and lobbies.):
 - 1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Board: 2 inches thick and 32-lb/cu. ft. nominal density.
- H. Exposed, outdoor-air plenum insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.
- I. Exposed, exhaust-air plenum insulation shall be one of the following:
 - 1. Mineral-Fiber Board: 3 inches thick and 3-lb/cu. ft. nominal density.

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. Ducts and Plenums, Concealed:
 - 1. None.
- D. Ducts and Plenums, Exposed:
 - 1. None.

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.

1.2 SUMMARY

- A. Section includes insulating the following HVAC equipment that is not factory insulated:
 - 1. Heating, hot-water pumps.
 - 2. Expansion/compression tanks.
 - 3. Air separators.
- B. Related Sections:
 - 1. Section 230713 "Duct Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."

1.3 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 attachment and covering of heat tracing inside insulation.
 - 3. Detail removable insulation at equipment connections.
 - 4. Detail application of field-applied jackets.
 - 5. Detail application at linkages of control devices.
 - 6. Detail field application for each equipment type.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate 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.

1.8 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Calcium Silicate:
 - 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. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - 2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- E. 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, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Sheet and K-FLEX LS.
- F. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 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. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 - 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-97.
 - b. Eagle Bridges - Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
 - 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."
- C. 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, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - 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. 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."
- 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.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 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 and outdoor 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.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above 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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. 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-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate 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.
- B. 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.
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.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 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 tank heads and tank side panels.

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.

2.9 SECUREMENTS

A. Bands:

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.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - 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.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 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.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.

3. 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.
 - 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.
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.

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. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- 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-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.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- 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. Manholes.
 5. Handholes.
 6. 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 100 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. Install adhesively attached insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 5. 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 from each end. Install wire or cable between two circumferential girdles 12 inches 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 o.c. Use this network for securing insulation with tie wire or bands.
 6. Stagger joints between insulation layers at least 3 inches.
 7. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 8. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 9. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- 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.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.6 FINISHES

- #### A. Flexible Elastomeric Thermal Insulation:
- After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.7 FIELD QUALITY CONTROL

- #### A. Perform tests and inspections.
- #### B. Tests and Inspections:
- Inspect field-insulated equipment, randomly, 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.
- #### C. Heating-hot-water air-separator/buffer tank insulation shall be one of the following:
1. Calcium Silicate: 3 inches thick.
 2. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.9 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. Equipment, Concealed:
 - 1. None.
- C. Equipment, Exposed:
 - 1. None.

END OF SECTION 230716

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Condensate drain piping, indoors.
 - 2. Heating hot-water piping, indoors.
 - 3. Refrigerant suction and hot-gas piping, indoors and outdoors.
- B. Related Sections:
 - 1. Section 230713 "Duct Insulation."
 - 2. Section 230716 "HVAC Equipment Insulation."

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," and "Indoor Piping 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.
 - 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.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 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. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. 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.
- I. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
 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. Knauf Insulation; Permawick Pipe Insulation.
 - b. Owens Corning; VaporWick Pipe Insulation.
 - J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 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. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 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.; Super-Stik.
- B. 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.
 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."
- 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. 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, 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.
 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, 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. 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. 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. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. 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.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-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. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, 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-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate 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.

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.
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."

C. ASJ Flashing Sealants, and Vinyl, 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. 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).
6. 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."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. 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: Color-code jackets based on system.
 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.

2.9 SELF-ADHESIVE, FIELD-APPLIED, OUTDOOR JACKETS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Polyguard Products, Inc.; Alumaguard Lite, or comparable product by one of the following:

1. **3M.**
 2. MFM Building Products Corp.
- B. General Requirements for Self-Adhesive Outdoor Jacket: Laminated vapor barrier and waterproofing membrane with perm rating of 0.00 perm (**0.00 metric perm**), when tested according to ASTM E 96/E 96M, for installation over either fiberglass or foam board insulation located above ground outdoors; consists of a foil polymer laminated film with a coating of rubberized bituminous compound or acrylic adhesive that allows membrane to self-adhere to the substrate.
- C. Alumaguard Lite: Multi-ply aluminum foil/polymer composite film coated with a low-temperature acrylic adhesive.
1. Stucco Embossed Silver Thickness: 9-mils (**0.23-mm**).

2.10 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. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, 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.
- C. 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.
- D. 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.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC 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. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 2. Width: 3 inches.
 3. Film Thickness: 4 mils.
 4. Adhesive Thickness: 1.5 mils.
 5. Elongation at Break: 145 percent.
 6. Tensile Strength: 55 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

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.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and 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] [4 inches] o.c.

- a. For below-ambient services, apply vapor-barrier mastic over staples.
- 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "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 Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as 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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. 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.

C. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presize jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-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.
5. 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.

3.9 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint PVC, aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly, 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.

3.11 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.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 - 1. NPS 1.5" and Smaller (inside conditioned space partition walls) : Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
 - 2. NPS 1.5" and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1.5 inches thick.

3. NPS 2" and Larger: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inch thick.

C. Refrigerant Suction and Hot-Gas Piping:

1. 0.5" and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 0.5 inch thick.
2. 0.625" and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 2 inches thick.

3.14 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. Piping, Concealed:

1. None.

C. Piping, All Exposed Piping below 9'-0" above finished floor (Excluding Mechanical Rooms):

1. PVC: 30 mils thick.
2. PVC Jacket Color: White or Color Coded by System.

3.15 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. Install jacket per manufacturer's recommendations. Miter fittings for neat appearance and to maintain water resistance.

C. Piping, Concealed:

1. None.

D. Piping, Exposed.

1. Outdoor, Field-Applied Jacket Schedule: Alumaguard Lite Embossed.

END OF SECTION 230719

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes commissioning process requirements for the following HVAC&R systems, assemblies, and equipment:
 - 1. Heat generation systems, including hot-water boilers systems.
 - 2. Cooling generation systems, including chilled-water systems & direct-expansion systems.
 - 3. Distribution systems, including air distribution (heating and cooling) systems, hot-water distribution systems, glycol distribution systems, chilled-water distribution systems, exhaust systems, air-handling units.
 - 4. Terminal and packaged units, including unit ventilators, unit heaters, fan-coil units, finned-tube radiation, split system AC units, VRV systems.
 - 5. Controls and instrumentation, including BAS
 - 6. Systems testing and balancing verification, including heating-water piping systems, chilled-water piping systems, domestic hot-water circulating systems, supply-air systems, return-air systems, and exhaust-air systems.
- B. Related Requirements:
 - 1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. DDC: Direct digital controls.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. "Systems," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- E. TAB: Testing, adjusting, and balancing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For BAS and HVAC&R Testing Technician.
- B. Construction Checklists: See related Sections for technical requirements for the following construction checklists:
 - 1. Vibration and seismic controls for HVAC&R piping and equipment.
 - 2. Instrumentation and control for HVAC&R.
 - 3. Heating-water piping and accessories.
 - 4. Cooling-water piping and accessories.
 - 5. Refrigerant piping.
 - 6. Metal ducts and accessories.
 - 7. Fans.
 - 8. Particulate air filtration.
 - 9. Air-handling units.
 - 10. Boilers.
 - 11. Pumps.
 - 12. VRV Systems

1.5 QUALITY ASSURANCE

- A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
 - 1. Journey-level or equivalent skill level with knowledge of BAS, HVAC&R, electrical concepts, and building operations.
 - 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
 - 3. International Society of Automation (ISA) Certified Control Systems Technician (CCST) Level I.
- B. HVAC&R Testing Technician Qualifications: Technicians to perform HVAC&R construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
 - 1. Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associates degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC&R systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC&R equipment, assemblies, and systems.
 - 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
 - 3. One of the following:

- a. National Environmental Balancing Bureau (NEBB) Certified Testing, Adjusting, and Balancing Technician.
 - b. Associated Air Balance Council (AABC) Certified Test and Balance Technician.
 - c. Owner retains the right to waive NEBB or AABC Certification.
- C. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform HVAC&R commissioning work, perform the following:
1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
 - a. Equipment/instrument identification number.
 - b. Planned commissioning application or use.
 - c. Manufacturer, make, model, and serial number.
 - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 2. Test equipment and instrumentation shall meet the following criteria:
 - a. Capable of testing and measuring performance within the specified acceptance criteria.
 - b. Be calibrated at the manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 - c. Be maintained in good repair and operating condition throughout the duration of use on this Project.
 - d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- D. Proprietary Test Instrumentation and Tools:
1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the commissioning process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
 - a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
 - 1) Instrument or tool identification number.
 - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
 - 3) Manufacturer, make, model, and serial number.
 - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
 - b. Include a separate list of proprietary test instrumentation and tools in the operation and maintenance manuals.
 - c. HVAC&R proprietary test instrumentation and tools become the property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.
- F. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- G. Construction Checklists: Prepare and submit detailed construction checklists for HVAC&R systems, subsystems, equipment, and components.
 - 1. Contributors to the development of construction checklists shall include, but are not limited to, the following:
 - a. HVAC&R systems and equipment installers.
 - b. TAB technicians.
 - c. HVAC&R instrumentation and controls installers.
- H. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Coordinator and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
 3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
 - J. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
 - K. Coordinate schedule with, and perform the following activities at the direction of, Commissioning Coordinator.
 - L. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment.
 - M. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
 1. Performance tests.
 2. Demonstration of a sample of performance tests.
 3. Commissioning tests.
 4. Commissioning test demonstrations.

3.2 TAB COMMISSIONING TESTS

A. TAB Verification:

1. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
2. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
3. Scope: HVAC&R air systems and hydronic piping systems.
4. Purpose: Differential flow relationships intended to maintain air pressurization differentials between the various areas of Project.
5. Conditions of the Test:
 - a. Commissioning Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
 - b. Systems operating in full heating mode with minimum outside-air volume
 - c. Systems operating in full cooling mode with minimum outside-air volume
 - d. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.

6. Acceptance Criteria:
 - a. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
 - b. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than two times the tolerances allowed.
 - c. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

END OF SECTION 230800

SECTION 23 09 23 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required, to provide a complete and functional building automation system (also identified as BMS, Direct Digital Control System For HVAC) including all necessary hardware and all operating and applications software as required for the complete performance of the Work, as shown on the Drawings, as specified herein. The building management system shall be an extension of the existing Niagara University Schneider Electric EcoStruxure Enterprise system.
- B. Related Sections: Related sections include, but shall not be limited to, the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Applicable general requirements for electrical Work specified within Divisions 23, 26 Specification Sections apply to this Section.
- C. Network level components of the system – workstations, servers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2004. No gateways shall be used for communication to controllers furnished under this section.
- D. At a minimum, provide controls for the following:
 - 1. Rooftop Units
 - 2. Boilers
 - 3. Hot Water Pumps
 - 4. Finned tube radiation control
 - 5. Cabinet Unit Heaters
 - 6. Unit Ventilators
 - 7. Heat Pumps
- E. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, Room Controllers, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete system of electrical interlocking wiring to fill the intent of the specification and provide for a complete and operable system. Except as otherwise specified, provide operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Contractors.

- F. The BAS system supplier shall review and study all HVAC drawings and the entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.
- G. All interlocking wiring, wiring and installation of control devices associated with the equipment listed below shall be provided under this Contract. When the BAS system is fully installed and operational, the BAS system supplier and representatives of the Owner will review and check out the system – see System Acceptance and Testing section of this document. At that time, the BAS system supplier shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.
- H. Provide services and manpower necessary for commissioning of the system in coordination with the HVAC Contractor, Balancing Contractor and Owner’s representative.
- I. All work performed under this section of the specifications will comply with all governing codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor, with guidance from the engineer, shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.
- J. Related Sections
 - 1. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units. Depending on the scope of the project, the complete specification may have numerous sections that interface to this section, including several from Division 23, & 26,

1.2 REFERENCES

- A. General, Code Compliance: The code listed below form a part of this Specification to the extent referenced. The codes are referred to in the text by the basic designation only. The edition/revision of the referenced code shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
 - 1. Standard
 - a. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
 - b. AHU: Air Handling Unit
 - c. BACnet: Building Automation Controls Network
 - d. BMS: Building Management System
 - e. DDC: Direct Digital Control
 - f. EIA: Electronic Industries Alliance
 - g. GUI: Graphical User Interface
 - h. HVAC: Heating, Ventilation, and Air Conditioning

- i. IEEE: Institute Electrical Electronic Engineers
- j. MER: Mechanical Equipment Room
- k. PID: Proportional, Integral, Derivative
- l. VAV: Variable Air Volume Box
- 2. Communications and protocols
 - a. ARP: Address Resolution Protocol
 - b. BACnet: Building Automation and Control Networks
 - c. CORBA: Common Object Request Broker Architecture
 - d. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
 - e. DDE: Dynamic Data Exchange
 - f. FTP: File Transfer Protocol
 - g. FTT: Free Topology Transceivers
 - h. HTTP: Hyper Text Transfer Protocol
 - i. IIOP: Internet Inter-ORB Protocol
 - j. IP: Internet Protocol
 - k. LAN: Local Area Network
 - l. LON: Echelon Communication – Local Operating Network
 - m. MS/TP: Master Slave Token Passing
 - n. OBIX: Open Building Information Exchange
 - o. ODBC: Open Database Connectivity
 - p. ORB: Object Request Broker
 - q. SNVT: Standard Network Variables Types
 - r. SQL: Structured Query Language
 - s. UDP: User Datagram Protocol
 - t. XML: eXtensible Markup Language
- 3. Controllers
 - a. ASD: Application Specific Device
 - b. AAC: Advanced Application Controller
 - c. ASC: Application Specific Controller
 - d. CAC: Custom Application Controller
 - e. DCU: Distributed Control Unit
 - f. HRC: Hotel Room Controller
 - g. LCM: Local Control Module
 - h. MC: MicroControllers
 - i. MPC: Multi-purpose Controller
 - j. NSC: Network Server Controller
 - k. PEM: Package Equipment Module
 - l. PPC: Programmable Process Controller
 - m. RC: Room controller
 - n. RPC: Room Purpose Controller

- o. SDCU: Standalone Digital Control Units
 - p. SLC: Supervisory Logic Controller
 - q. SSC: Standalone Server Controller
 - r. UEC: Unitary Equipment Controller
 - s. VAVDDC: Variable Air Volume Direct Digital Controller
4. Tools and Software
- a. AFDD: Automated Fault Detection and Diagnostic
 - b. APEO: Automated Predictive Energy Optimization
 - c. DR: Demand Response
 - d. CCDT: Configuration, Commissioning and Diagnostic Tool
 - e. BPES: BACnet Portable Engineering Station
 - f. LPES: LON Portable Engineering Station
 - g. POT: Portable Operator's Terminal
 - h. PEMS: Power and Energy Management Software
 - i. MTBF: Mean Time Between Failure

1.4 SYSTEM DESCRIPTION

- A. In accordance to the scope of work, the system shall also provide a graphical, web-based, operator interface that allows for instant access to any system through a standard browser. The contractor must provide PC-based programming workstations, operator workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions.
- B. For this project, the system shall consist of the following components:
- 1. Administration and Programming Workstation(s): The BAS system supplier shall include Operation software and architecture as described in Part 2 of the specification. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network server controllers and the standalone controllers. No third party front-end workstation software will be acceptable. Workstations must conform to the B-OWS BACnet device profile.
 - 2. Web-Based Operator Workstations: The BAS system supplier shall furnish licenses for web connection to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. All engineering work, such as trends, reports, graphics, etc. that are accomplished from the WorkStation shall be available for viewing through the web browser interface without additional changes. The web-based interface must conform to the B-OWS BACnet device profile. There will be no need for any additional computer based hardware to support the web-based user interface.
 - 3. Ethernet-based Network Router and/or Network Server Controller(s): The BAS system supplier shall furnish needed quantity of Ethernet-based Network Server Controllers as described in Part 2 of the specification. These controllers will connect directly to the Operator Workstation over Ethernet at a minimum of 100mbps, and provide communication to the Standalone Digital Control Units and/or other Input/Output Modules. Network Server Controllers shall conform to BACnet device profile B-BC. Network controllers that utilize RS232 serial communications or ARCNET

- to communicate with the workstations will not be accepted. Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Building Controllers (B-BC).
4. Standalone Digital Control Units (SDCUs): Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment. Each BACnet protocol SDCU shall conform to the BACnet device profile B-AAC. BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Advanced Application Controllers (B-AAC).
- C. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Modbus, XML and HTTPS for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Server Controllers (NSCs), user workstations and a local host computer system.
 - D. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.
 - E. The system shall enable an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol and/or ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. Native support for the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol are required to assure that the project is fully supported by the HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.
 - F. The system shall enable an architecture that utilizes a MS/TP selectable 9.6-76.8 Kbaud protocol, as a common communication protocol between controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The ANSI / ASHRAE™ Standard 135-2004, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.
 - G. LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth where necessary or desired.
 1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide functionality lines for such encapsulation and shall be based on industry standard protocols.
 2. The products used in constructing the BMS shall be LonMark™ compliant.
 3. In those instances, in which Lon-Mark™ devices are not available, the BMS system supplier shall provide device resource files and external interface definitions for LonMark devices.
 - H. The software tools required for network management of the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans and are required to meet the functional intent, shall be provided without additional cost to the Owner. BACnet clients shall comply with the BACnet Operator Workstation (B-OWS) device profile; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet IP or MS/TP. Physical connection of LonWorks devices shall be via Ethernet IP or FTT-10A.

- I. The system shall provide support for Modbus TCP and RTU protocols natively, and not require the use of gateways.
- J. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.
 - 1. The supplied system must incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs. The system shall not require JAVA to be enabled in the browser.
 - 2. Data shall reside on a supplier-installed server for all database access.
 - 3. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.
- K. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the approved manufacturer's local field office. The approved manufacturer's local field office shall have a minimum of 3 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, hardware and software engineering, calibration and checkout of the system shall be by the employees of the approved manufacturer's local field office and shall not be subcontracted. The control contractor shall have an in place support facility within 100 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have 24 hours/day, 7 days/week emergency service available.
- L. Provide the Commissioning, configuration and diagnostic tool (CCDT), color display personnel computer, software, and interfaces to provide uploading/downloading of High Point Count Controllers (AAC), Unitary Equipment Controllers (UEC) and VAV controllers (VAVDDC), monitoring all BACnet objects, monitoring overrides of all controller physical input/output points, points include the ability to have timed overrides, and editing of controller resident time schedules.
 - 1. The iBMS shall integrate to a security access control management system specified in Division 28. Integration shall be performed by contractor of Division 25 00 10. See specification section 25 00 10 for exact requirements.

1.5 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section 01 33 00 Submittals and Section 23 00 10 Mechanical, in addition to those specified herein.
 - 1. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the drawings, the Contractor shall furnish a CD containing the identical information. Drawings shall be B size or larger.
 - 2. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typicals will be allowed where appropriate.

3. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and air flow station schedules shall indicate size, configuration, capacity and location of all equipment.
4. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs. Diagrams shall be on 11" by 17" foldouts. If color has been used to differentiate information, the printed copies shall be in color.
5. Submit one (1) electronic copy of submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor, prior to submitting, shall check all documents for accuracy.
6. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.
7. The following is a list of post construction submittals that shall be updated to reflect any changes during construction and re-submitted as "As-Built".
 - a. System architecture drawing.
 - b. Wiring diagram for individual components
 - c. System flow diagram for each controlled system
 - d. Instrumentation list for each controlled system
 - e. Sequence of control
 - f. A matrix sheet detailing all system addresses and communication settings for the following:
 - 1) All IP network addresses & settings
 - 2) All BMS device addresses & communication settings
 - g. Operation and Maintenance Manuals
8. Software shall be provided:
 - a. Submit a copy of all software installed on the servers and workstations.
 - b. Submit all licensing information for all software installed on the servers and workstations.
 - c. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
 - d. Submit all licensing information for all of the software used to execute the project.
 - e. All software revisions shall be as installed at the time of the system acceptance.
 - f. Firmware Files
 - g. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
 - h. This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
 - i. Submit a copy of all application files that were created during the execution of the project.
 - j. Submit a copy of all graphic page files created during the execution of the project.

1.6 QUALITY ASSURANCE

- A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 15 years.
 - 1. The Building Management System contractor shall have a full service facility within 50 miles of the project that is staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The contractor's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.
- B. All bidders must be authorized distributors or branch offices of the manufacturers specified.
- C. The following bidders have been pre-qualified:
 - 1. Schneider Electric EcoStruxure provided and installed by Stark Tech

1.7 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor Control Centers," "Panel boards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".
- E. Coordinate with the Owner's IT department on locations for NSC's, Ethernet communication cabling and TCP/IP addresses.

1.8 OWNERSHIP

- A. The Owner shall retain licenses to software for this project.
- B. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition off this contractor. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement, but shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software.
- C. The licensing agreement shall not preclude the use of the software by individuals under contract to the owner for commissioning, servicing or altering the system in the future. Use of the software by individuals under contract to the owner shall be restricted to use on the owner's computers and only for the purpose of commissioning, servicing, or altering the installed system.
- D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
 - 1. Server and workstation software

2. Application programming tools
3. Configuration tools
4. Network diagnostic tools
5. Addressing tools
6. Application files
7. Configuration files
8. Graphic files
9. Report files
10. Graphic symbol libraries
11. All documentation

1.9 WORK BY OTHERS

- A. The BAS system supplier shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.
- B. The BAS system supplier shall furnish all Control Dampers, Control Valves, Flow Meters for installation by the Mechanical Contractor and/or others.
- C. The BAS system supplier shall provide field supervision to the designated contractor for the installation of the following:
 1. Automatic control dampers
 2. Blank-off plates for dampers that are smaller than duct size.
 3. Sheet metal baffles plates to eliminate stratification.
 4. The Electrical Contractor shall provide:
 - a. All 120VAC power wiring to motors, heat trace, junction boxes for power to BAS panels.
 - b. Furnish smoke detectors and wire to the building fire alarm system. HVAC Contractor to mount devices. BAS system supplier to hardwire to fan shut down.
- D. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- E. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

1.10 WARRANTY

- A. All components, system software, and parts furnished and installed by the BMS system supplier shall be guaranteed against defects in materials and workmanship for 1 year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS system supplier at no charge during normal working hours during the warranty period. Materials furnished but not installed by

the BMS system supplier shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:
1. Schneider Electric EcoStruxure furnish and installed by Stark Tech

2.2 OPEN, INTEROPERABLE SYSTEM ARCHITECTURE

A. A.General

1. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable.
2. An Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks.
3. The Enterprise Level BAS shall support built-in reporting functionality without dependency on other software.
4. The Enterprise Level BAS shall support standard accessing of data for third party reporting or analytics software.
5. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
6. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows SQL based computer. The Reports Server can be installed on the same computer as the Enterprise Server. In addition, Timescale DB compression can be used to allow the reduction of server disk space.
7. To accommodate very large sites with requirements for full data aggregation, a central server shall consist of a server that can gather and report on data from as many as fifty different Enterprise Level BAS Servers.
8. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, LonWorks IP, and/or Modbus TCP protocol.
9. The BAS shall support BACnet SC node, hub and router functions as defined in the Annex AB of ANSI/ASHRAE Standard 135-2020

- B. Modbus RTU/ASCII (and J-bus), Modbus TCP, BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported.

- C. A sub-network of SDCUs using the BACnet IP protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- D. The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connections to the campus WAN shall be used for each device that connects to the WAN.
- E. The fieldbus layer shall support all of the following types of SDCUs:
 - 1. BACnet IP SDCU requirements: The system shall consist of one or more BACnet/IP field buses managed by the Network Server Controller. The field bus layer shall consist of up to 50 IP SDCUs in daisy chain topology, or 39 if using RSTP, per layer, with a max of 5 sub networks in daisy chain for a total of 250 SDCUs or 6 sub networks in RSTP for a total of 234 SDCUs. The field bus layer shall consist ONLY of BACnet IP SDCUs. No other protocols, including BACnet MS/TP, shall be acceptable.
- F. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.
- G. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.
- H. System Expansion
 - 1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
 - 2. Web-based operation shall be supported directly by the NSCs and require no additional software.
 - 3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.
 - 4. The system shall be able to operate normally and without restriction at multiple software version levels with the only requirement that each element of the hierarchy be at least as new a version as the newest version in the level below it. In other words, Enterprise Servers will be able to manage NSCs of different version provided that the Enterprise Server was the same or more recent version than the most recent NSC version.
- I. All Network Server Controllers must natively support the BACnet IP, BACnet MS/TP, LonWorks FTT-10, Modbus TCP, Modbus RTU (RS-485 and RS-232), and Modbus ASCII protocols.

2.3 OPERATOR WORKSTATION REQUIREMENTS

- A. A.General

1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project provide a minimum of 3 concurrent client licenses at the enterprise level. Client licenses are licenses that can be used for variable designations of the users choosing; i.e. operator, engineering, or web capabilities.
 2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database.
 3. The BAS Web-based workstations (webstations) shall be able to support a minimum of 100 concurrent operator users.
 4. All configuration workstations shall be personal computers operating under the Microsoft Windows operating system. The application software shall be capable of communication to all Network Server Controllers and shall feature high-resolution color graphics, alarming, trend charting. It shall be user configurable for all data collection and data presentation functions.
 5. A minimum of 1 physical Workstation shall be allowed on the Ethernet network. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations since the changes are accomplished to the databases within the NSC. Systems with a central database will not be acceptable.
- B. Enterprise Central, Enterprise Server, Administration/Programming Workstation, and Webstation Requirements
1. The Enterprise Central shall consist of the following:
 - a. Processor
 - 1) Minimum: Intel Core i5 @ 3.0 GHz or equivalent
 - 2) Recommended: Intel Core i5 @ 4.0 GHz or better
 - b. Memory
 - 1) Minimum: 6GB
 - 2) Recommended: 12GB or higher
 - c. Operating systems:
 - 1) Microsoft Windows 10 64-bit
 - 2) Microsoft Windows 11
 - 3) Microsoft Windows Server 2012 R2 64-bit
 - 4) Microsoft Windows Server 2016
 - 5) Microsoft Windows Server 2019
 - 6) Microsoft Windows Server 2022
 - d. 10/100MBPS Ethernet NIC
 - e. Storage
 - 1) Minimum: 1TB
 - 2) Recommended: 4TB
 - 3) Solid State Drive recommended
 - f. Required additional software:
 - 1) Microsoft .Net 4.7.2 and later
 - g. License agreement for all applicable software
 - h. External log storage option
 - 1) PostgreSQL 11.0 and later
 - 2) TimescaleDB 1.2 and later

- 3) Microsoft SQL Server 2016 SP1 and later
2. The Enterprise Server shall consist of the following:
 - a. Processor
 - 1) Minimum: Intel Core i5 @ 2.0 GHz or equivalent
 - 2) Recommended: Intel Core i5 @ 3.0 GHz or better
 - b. Memory
 - 1) Minimum: 4GB
 - 2) Recommended: 8GB or higher
 - c. Operating systems:
 - 1) Microsoft Windows 7 64-bit
 - 2) Microsoft Windows 10 64-bit
 - 3) Microsoft Windows 11
 - 4) Microsoft Windows Server 2012 R2 64-bit
 - 5) Microsoft Windows Server 2016
 - 6) Microsoft Windows Server 2019
 - 7) Microsoft Windows Server 2022
 - d. 10/100MBPS Ethernet NIC
 - e. Storage
 - 1) Minimum: 100GB
 - 2) Recommended: 1TB
 - 3) Solid State Drive recommended
 - f. Required additional software:
 - 1) Microsoft .Net 4.7.2 and later
 - g. License agreement for all applicable software
 - h. External log storage option
 - 1) PostgreSQL 11.0 and later
 - 2) TimescaleDB 1.2 and later
 - 3) Microsoft SQL Server 2016 SP1 and later
3. The Workstation shall consist of the following:
 - a. Processor
 - 1) Minimum: Intel Core i5 @ 2.0 GHz or equivalent
 - 2) Recommended: Intel Core i5 @ 3.0 GHz or better
 - b. Memory
 - 1) Minimum: 4GB
 - 2) Recommended: 8GB or higher
 - c. Operating systems:
 - 1) Microsoft Windows 7 64-bit
 - 2) Microsoft Windows 10 64-bit
 - 3) Microsoft Windows 11
 - 4) Microsoft Windows Server 2012 R2 64-bit
 - 5) Microsoft Windows Server 2016
 - 6) Microsoft Windows Server 2019
 - 7) Microsoft Windows Server 2022
 - d. 10/100MBPS Ethernet NIC

- e. Storage
 - 1) Minimum: 20GB
 - 2) Recommended: 1TB
 - 3) Solid State Drive recommended
 - f. Required additional software:
 - 1) Microsoft .Net 4.7.2 and later
 - g. License agreement for all applicable software
4. Web-Based Operator PC Requirements
- a. Any user on the network can access the system, using the following software:
 - b. Minimum:
 - 1) Google Chrome 61 or higher
 - 2) Mozilla Firefox 60 or higher
 - 3) Microsoft Edge (EdgeHTML) 16 or higher
 - 4) Safari 11.1 or higher
 - c. Recommended:
 - 1) Google Chrome 71 or higher
 - 2) Mozilla Firefox 64 or higher
 - 3) Microsoft Edge (EdgeHTML) 17 or higher
 - 4) Safari 11.4 or higher
- C. General Administration and Programming Workstation Software
- 1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
 - 2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
 - 3. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information will be available in graphic or text displays stored at the NSC. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.
- D. User Interface:
- 1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of “hot-spots” that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user’s “PC Desktop” – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might

be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.

2. System shall be able to automatically switch between displayed metric vs. imperial units based on the workstation/webstations localization.
3. The BMS workstation/webstations shall be capable of multiple language display, including English, Spanish, German, French, Japanese, Italian, Finnish, Portuguese, Swedish, Russian, and traditional and simplified Chinese. The multiple languages shall not require additional add on software from the standard workstation installer and shall be selectable within said workstation.
4. Webstations shall have the capability to automatically re-direct to an HTTPS connection to ensure more secure communications.
5. Personalized layouts and panels within workstations shall be extended to webstations to ensure consistent user experiences between the two user interfaces.
6. Webstations shall give the user similar capabilities within the graphics pages as are given within the workstation but shall be mobile responsive for use on smaller devices.
7. Servers and clients shall have the ability to be located in different time zones, which are then synchronized via the NTP server.
8. Workstation shall indicate at all times the communication status between it and the server.
9. The BMS web interface shall enable presentation mode whereby any functionality for interactivity shall be disabled.
10. The BMS web interface shall automatically detect light mode and dark mode settings in the operating system and adapt accordingly.
11. The BMS web interface shall allow override of the operating systems light/dark mode settings so that the setting can be enabled independent of the operating system's setting.
12. The BMS web interface shall automatically respond and adapt to different screen sizes and orientations from smart phone to smart televisions of any size.
13. The BMS web interface shall support slideshow functionality.
14. The BMS web interface shall support full screen mode displaying Alarm views / graphics / dashboards / Custom Reports.

E. User Access and Permissions

1. The BMS system shall allow for creation of one account per user.
2. The BMS shall support Groups where User Accounts associated with the group can inherit group permissions.
3. The BMS shall be able to specify each user account or user group accessibility at granularity of "Object Property" level.
4. The BMS permission system shall be possible to integrate with Windows Active directory.
5. The BMS shall be able to report on the permission level across account / group for review / archiving / audit.
6. This username/password combination shall be linked to a set of capabilities within the software, set and editable only by user with system administrator privileges. The sets of capabilities shall include: edit or View only, Acknowledge alarms, Enable/disable Program and change values.
7. The system shall allow the above capabilities to be applied independently to each and every class of object in the system.
8. The BMS shall support integration with Windows Active Directory for user log on credentials.

9. The BMS shall support Single Sign On via SAML 2.0 Authentication scheme over HTTPS enabling secure navigation across multiple systems without the need to login
10. The BMS shall support configurable reminder for “Days until password expires”.
11. The BMS shall support configurable password policy across:
 - a. Minimum number of characters
 - b. Minimum number of lowercase characters
 - c. Minimum number of numeric characters
 - d. Minimum number of special characters
 - e. Number of consecutive unique passwords before reuse
 - f. No more than three repeating identical characters
12. The BMS user account management shall support password policy with the following components:
 - a. Mandatory change of password at first logon with default credentials
 - b. Disabling of all imported user accounts by default
 - c. Custom password complexity rules and its enforcement
 - d. Custom password reuse and its enforcement
 - e. Configurable black listing of passwords to limit the use of common known passwords (e.g. password)
 - f. Password aging rules
13. The BMS shall be capable of enabling an anonymous access (guest account) to previously engineered views such as dashboards, graphics, etc. with configurable permissions and without username or password.
14. It shall be possible to configure the BMS system so that the guest account is used by default to simplify presentation of Kiosk Mode across multiple screens
15. The BMS shall provide time configurability to logout the user and to revert to a preconfigured presentation view, such as offered by the Guest account functionality.
16. The BMS shall provide configurability in managing access and permission levels based on location, IP addresses and address ranges, Schedule and Time of day and combination thereof.
17. The BMS Shall support option of disabling batch operation (Multi Alarm Acknowledgement) on Alarms to force operator to analyze and act on each alarm individually.

F. System Security

1. The BMS system supplier vendor shall be certified to Security Development Lifecycle process that is certified to IEC 62443-4-1 by a reputable third party independent lab.
2. The BMS system supplier vendor shall be certified to ISO.IEC 27034 controls/guidance for IT and OT convergence in association with the IEC 62443 Security Development Lifecycle processes.
3. The BMS system supplier shall be subjected to regular and verifiable best practice cyber security testing by the system supplier. Results of this testing shall be made available upon request prior to deployment of the system.

4. The BMS system supplier shall provide cyber security service incident escalation through help desk on a 7/24/365 basis.
5. The BMS shall support configuration for inactivity auto log-off of logged clients
6. The BMS system shall support Self-Signed Certificates, Default Certificates and/or Certification Authority (CA) certificates.
7. The BMS client communications (web access or rich client access) shall support TLS 1.3 encryption.
8. The BMS shall allow configuration in disabling all devices and software that support HTTP and require access via HTTPS.
9. The BMS must be able to Alarm or generate notification on failed access attempts
10. The BMS Servers shall support SNMP V3 monitoring of network performance and stack statistics for the purpose of managing denial of service attacks
11. The BMS shall support the feature to alarm on a predetermined period of time until the default password for each device is changed from the default factory setting.
12. The BMS shall support encrypted password authentication for all web services whether serving or consuming.
13. The BMS shall have the capability to use blacklisted and whitelisted IPs/MAC addresses to gate access
14. The BMS shall have the capability to differentiate, limit or enable, user access depending on Client's IP address/range (where) and time of day (when) the user is accessing the system.
15. The BMS system supplier vendor shall supply the latest Anti-virus / anti-malware software to be installed and updates applied automatically during the warranty period. Virus updates will be monitored to detect possible negative impacts to the operation of the PC server application software.

G. Configuration Interface

1. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions.
2. The configuration interface shall also include support for user defined object types. These object types shall be used as building blocks for the creation of the BAS database. They shall be created from the base object types within the system input, output, string variables, setpoints, etc., alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of user defined object types shall be able to be set up as a predefined aggregate of subsystems and systems. The configuration interface shall support copying/pasting and exporting/importing portions of the database for additional efficiency. The system shall also maintain a link to all "child" objects created. If a user wishes to make a change to a parent object, the software shall ask the user if he/she wants to update all of the child objects with the change.

H. Color Graphic Displays

1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.
2. Requirements of the color graphic subsystem include:
 - a. At a minimum, the user shall have the ability to import .gif, .png, .bmp, .jpeg, .tif, and CAD generated picture files as background displays, and layering shall be possible.
 - b. The system shall support HTML5 enabled graphics.
 - c. It shall be possible for the user to use JavaScript to customize the behavior of each graphic.
 - d. The editor shall use Scalable Vector Graphics (SVG) technology.
 - e. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, and graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels.
 - f. Support for high DPI icons shall be included and automatically chosen if viewing on a high definition display such as Retina or 4K displays.
 - g. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
 - h. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
 - i. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.
 - j. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.
 - k. Graphics should rescale based on whatever monitor or viewing device is being used.
 - l. Be able to create graphics on varying layers that can be moved and repeated.
 - m. Be able to create graphics within varying window panes that can be moved and/or referenced. For example, creating the graphical menu within a pane and referencing it on every graphics page, therefore not rebuilding thus allowing for a single spot for updates that get pushed to all the pages that reference it.
 - n. The ability to create re-usable cascading menus.
 - o. The ability to have multiple instances of a graphic and edit one instance to change all.
3. Additionally, the Graphics Editor portion of the Engineering Software shall provide the following capabilities:
 - a. Create and save pages.
 - b. Group and ungroup symbols.
 - c. Modify an existing symbol.
 - d. Modify an existing graphic page.
 - e. Rotate and mirror a symbol.
 - f. Place a symbol on a page.
 - g. Place analog dynamic data in decimal format on a page.

- h. Place binary dynamic data using state descriptors on a page.
 - i. Create motion through the use of animated .gif files or JavaScript.
 - j. Place test mode indication on a page.
 - k. Place manual mode indication on a page.
 - l. Place links using a fixed symbol or flyover on a page.
 - m. Links to other graphics.
 - n. Links to web sites.
 - o. Links to notes.
 - p. Links to time schedules.
 - q. Links to any .exe file on the operator work station.
 - r. Links to .doc files.
 - s. Assign a background color.
 - t. Assign a foreground color.
 - u. Place alarm indicators on a page.
 - v. Change symbol/text/value color as a function of an analog variable.
 - w. Change a symbol/text/value color as a function of a binary state.
 - x. Change symbol/text/value as a function of a binary state.
 - y. All symbols used by Schneider Electric EcoBuilding Business in the creation of graphic pages shall be saved to a library file for use by the owner.
- I. The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user-configurable.
- J. Alarm Management
- 1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
 - 2. Alarm management features shall include:
 - a. A minimum of 1000 alarm notification levels at the NSC, workstation, and webstation levels.
 - b. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.
 - c. At the Enterprise level the minimum number of active and viewable alarms shall be 10,000.
 - d. It shall be possible for the user to sort, filter and search on any available criteria such as priority, category, origin, alarm type, etc.
 - e. An active alarm viewer shall be included which can be customized for each user or user type to a hide or display any alarm attributes.
 - f. It shall be possible to present alarms with configurable colors based on priority, category, origin, alarm type, etc.
 - g. It shall be possible to linking files/documents/hyperlinks/navigation links/graphics link to an alarm for easy access upon occurrence

- h. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
 - i. Alarm notifications must support multiple distribution methods within one notification
 - j. On alarm, it shall be possible to notify via email to a preconfigured list of recipients . through a Simple Mail Transfer Protocol (SMTP) or secure email using Simple Mail Transfer Protocol Secure (SMTPS). No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
 - k. On alarm, it shall be possible to notify via SNMP
 - l. On alarm, it shall be possible to notify via file (on disk) that would be consumable by other alarm management services
 - m. An operator shall have the capability to assign an alarm to another user of the system.
 - n. Individual alarms shall be able to be assigned to a user automatically via a preconfigured list of users and date/time. For example, a critical high temp alarm can be configured to be assigned to a Facilities Dept or to a Central Alarming workstation depending on time/date.
 - o. Playing an audible sound on alarm initiation or return to normal.
 - p. It shall be possible assigning a custom audio sound to each alarm / alarm-criteria (priority, category, origin, alarm type, etc.)
 - q. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
 - r. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
 - s. The alarm viewer can be configured to auto hide alarms when triggered.
 - t. An operator shall have the capability to save and apply alarm favorites.
 - u. Alarms shall be configurable such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
 - v. Alarms shall be configurable such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
 - w. It shall be possible to configure user-actions via user/group permissions when responding to an alarm
 - x. All operator actions responding to an alarm must be audit trailed.
- K. Static Paginated Reporting / Custom Reporting
- 1. The BMS Software and Network Servers shall support built-in native reporting capability without dependency on any external software
 - 2. It shall be possible to generate custom reports manually, via Schedule, Alarm triggered or custom conditions (e.g. program/schedule/etc.)
 - 3. The Custom Reporting shall have no dependency on external database
 - 4. The Custom Reporting shall have the capability of reporting on the full range of available data, most recent to historical data.
 - 5. It shall be possible to generate reports containing current active alarms

6. The Building Management System software shall natively be capable of producing custom reports in txt, xlxs and pdf file formats.
7. The Custom Report capability at the BMS software shall support digital signing of pdf for traceability and authenticity.

L. Dashboards

1. Dashboards shall provide rapid identification of real-time and historical trends, including energy use, operational efficiencies and critical metrics.
2. Using the Native Web Browser interface the system must allow for the selection, from a wide range of layouts and widgets (dashboard components), of items to create Dashboards
3. System must allow for dashboard view customization and selection of data points via the web browser and w/o any tools or prior training.
4. Built-in dashboards - A basic set of dashboard components shall be provided as part of the project. At a minimum, the following dashboard components functionality shall be provided for the Owner's use:
 - a. Resource Utilization
 - 1) This is used to illustrate the comparative consumption of a resource (like energy) over a flexible time period.
 - 2) The information is ordered by location and multiple locations may be plotted on the same columnar chart for clear analysis and comparison.
 - b. Utility Performance Index
 - 1) This enables the creation and visualization of one or more Key Performance Index (KPI) charts for comparisons of resource utilization efficiencies for multiple locations.
 - 2) A typical use of this is in displaying a "scatter plot" of consumption (y-axis) versus consumption per unit area (x-axis).
 - 3) For example, an "Energy" KPI can be displayed by selecting the locations of interest (e.g. all Offices on Campus), selecting the vertical axis variable as Electric Consumption (kWh) and the horizontal axis as a "normalized" metric, such as "kWh per SFt".
 - c. Real time Gauges
 - 1) Gauges allow the Owner to track values such as temperature, pressure, humidity and level in real time.
 - d. Historical Gauges
 - 1) Gauges allow calculation of values based on historical data; for instance presenting max/min/average temperature/pressure/humidity over a given period
 - e. Period over Period Comparison
 - 1) It shall be possible to visually compare historical data (e.g. temperature, energy, etc.) across multiple overlapping time periods (hours, days, weeks, etc.)
5. Custom dashboard components –
 - a. Custom dashboard components shall be able to present any information from the BMS (e.g. system health data, alarms, trends, events, user access, etc.)

- b. The BMS shall allow creation of customized dashboard components in to presenting meaningful information as per customer
6. The BMS Web based operating environment shall allow the Operator to update multiple setpoint or parameter in one single operation that is accessible via search or graphics.
7. The BMS Shall support custom or out-of-the-box visual dashboards for BMS Alarms and Events that enables interactive visualization, analysis and supporting organizational KPIs. At minimum there shall be an:
 - a. Interactive Alarms and Events Sankey Chart with drill down capability across: Category, origin: Server/Controller, Priority, Types, assigned vs unassigned, Status and user activity, Assignment (who)
 - b. Historical Alarm Count widget that shows how number of alarms have evolved overtime
 - c. Interactive Pie Chart for alarms and events to illustrate proportion of user defined attribute vs all the total alarm/events in the system for a user defined timeline.
 - d. Interactive Pareto Chart enables focusing on the higher impact alarms and events depending on the occurrence.
 - e. Tracking of Alarms and Event KPIs [Assigned/unassigned alarms[workload], Alarm Counts [system stability], filter by different parts of the system (building / server /etc.)

M. Scheduling

1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.
3. Schedules shall be programmable for a minimum of one year in advance.
4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.
5. Additionally, from the operator webstations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.
7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
10. It should accommodate a minimum of 16 priority levels.
11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

N. Programmer's Environment

1. Programming in the NSC shall be either in graphical block format or line-programming format or both.
2. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
3. The programmer's environment will include access to a superset of the same programming language supported in the SDCUs.
4. NSC devices will support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs. Both languages will have debugging capabilities in their editors.
5. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
6. The system shall be capable of creating 'custom types'. These types can be created within the programming environment, graphics, or as full controller 'templates' that can be pushed to any other variable pertaining to it to allow for singular reference to multiple objects. This allows easing of updating/changes allowing the use to make a singular change and push to all connected instances.
7. It shall be possible to view graphical programming live and real-time from the Workstation.
8. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
9. Key terms should appear when typing (IntelliType).
10. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different function.
11. The system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.

O. Saving/Reloading

1. The workstation software shall have an application to save and restore NSC and field controller memory files.
2. For the NSC, this application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

2.4 NETWORK SERVER CONTROLLERS (NSC)

- A. The BACnet NSs shall support BACnet SC node, hub and router functions as defined in the Annex AB of ANSI/ASHRAE Standard 135-2020
- B. Network Server Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
- C. The BACnet NSC shall be classified as a "native" BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).

- D. The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.
- E. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices.
- F. Whitelisting of file extensions for documents shall be capable.
- G. Encrypted and authenticated communication shall be configurable for non-open protocol communications using TLS 1.3.
- H. The NSCs shall support Simple Network Management Protocol version 3 (SNMPv3) for monitoring of the NSCs using a Network Management Tool.
- I. The NSCs shall support remote system logging for used by System Information and Event Monitoring (SIEM) software.
- J. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler.
- K. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.
- L. It shall be capable of executing application control programs to provide:
 - 1. Calendar functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm monitoring and routing
 - 5. Time synchronization by means of an Internet site including automatic synchronization
 - 6. Native integration of LonWorks controller data and Modbus controller data or BACnet controller data and Modbus controller data
 - 7. Network Management functions for all LonWorks based devices
- M. Hardware Specifications
 - 1. Memory:
 - a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.
 - 2. Each NRC shall provide the following on-board hardware for communication:
 - a. Two 10/100b Ethernet for communication to Workstations, other NRCs, IP field bus controllers, other SDCUs, and onto the internet.
 - 1) The two Ethernet ports shall support active switch and BACnet/IP communication protocols.
 - 2) Support IPv4 or IPv6 addressing
 - 3) Ethernet port 1 shall support static or DHCP client configuration for communication to Workstation or other NSCs

- 4) Ethernet port 2 shall support switch mode or DHCP server to set addressing of DHCP client devices
 - 5) It shall be possible to disable Ethernet port 2
 - 6) In DHCP server mode, the Ethernet port 2 shall support 50 BACnet/IP field controllers in daisy chain configuration directly from the port
 - 7) Each NSC shall be able to support a total of 250 IP SDCUs in daisy chain configuration (5 sub networks via switch)
 - 8) If using RSTP (Rapid Spanning Tree Protocol) with a managed switch (with IEEE 802.1W or IEEE 802.1Q-2014 support), Ethernet port 2 shall support up to 39 devices
 - 9) Each NSC shall be able to support a total of 234 IP SDCUs in RSTP configuration (6 sub networks via managed switch)
 - 10) Where a switch is needed, use a Cisco 9000 Catalyst or IE switch, EtherWAN EX63402-01B, or other equal and approved equivalent.
- b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable)
 - c. One TP/FT port for communication to LonWorks devices.
 - d. One device USB port
 - e. One host USB port
3. The NSC shall conform to a small footprint no larger than 100W x 125H x 75D mm (3.94W x 4.92H x 2.95D in).

N. Modular Expandability:

1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
2. One shall be able to “hot-change” (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic.
3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected.

O. Hardware Override Switches:

1. All digital outputs shall, optionally, include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

P. Universal Input Temperatures

1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.
 - a. 10 kohm Type I (Continuum)
 - b. 10 kohm Type II (I/NET)
 - c. 10 kohm Type III (Satchwell)
 - d. 10 kohm Type IV (FD)
 - e. Linearized 10 kohm Type V (FD w/11k shunt)

- f. Linearized 10 kohm (Satchwell)
 - g. 1.8 kohm (Xenta)
 - h. 1 kohm (Balco)
 - i. 20 kohm (Honeywell)
 - j. 2.2 kohm (Johnson)
2. In addition to the above, the system shall be capable of using the below RTD sensors, however it is not required that all universal inputs be compatible with them.
- a. PT100 (Siemens)
 - b. PT1000 (Sauter)
 - c. Ni1000 (Danfoss)

Q. Local Status Indicator Lamps:

1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.

R. Real Time Clock (RTC):

1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.
2. The RTC date and time shall also be accurate, up to 10 days, when the NSC is powerless.
3. No batteries may be used to for the backup of the RTC.

S. Power Supply:

1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.
2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.

T. Automatic Restart After Power Failure:

1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.

U. Data Retention:

1. During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it must not use batteries to achieve it.

V. Software Specifications

1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the

system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.

2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

W. User Programming Language:

1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
2. Network Server Controllers that use a “canned” program method will not be accepted.

X. Control Software:

1. The NSC shall have the ability to perform the following pre-tested control algorithms:
 - a. Proportional, Integral plus Derivative Control (PID)
 - b. Two Position Control
 - c. Digital Filter
 - d. Ratio Calculator
 - e. Equipment Cycling Protection
2. The NSC has the ability to be implemented in a containerized software version, deployed as a Docker Container that provides server software function without the need for hardware controllers and power supplies.
 - a. Runs on any OS with Docker x86_64 support
 - b. Multiple instances are supported on the same OS

Y. Mathematical Functions:

1. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

Z. NSCs shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop

7. Night Setback Control
8. Enthalpy Switchover (Economizer)
9. Peak Demand Limiting
10. Temperature Compensated Duty Cycling
11. CFM Tracking
12. Heating/Cooling Interlock
13. Hot/Cold Deck Reset
14. Hot Water Reset
15. Chilled Water Reset
16. Condenser Water Reset
17. Chiller Sequencing

AA. History Logging:

1. Each NSC controller shall be capable of **LOCALLY** logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.
2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.
5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans.
6. Tooltips shall be present, magnetic, and visible based on users preference.
7. Comments shall be visible whenever viewing the trend log list.
8. System shall give indication of memory usage and be able to alert the user if too many logs are allocated.
9. The BMS software and Network Servers shall support recording of all historical data, independent of any limitation in its local memory, which will be readily available for reporting and analysis without additional configurations or actions.
10. All historical data shall be available for use by the operator to access in BMS or a third-party reporting systems.

BB. Alarm Management:

1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.

2. There is no limit to the number of alarms that can be created for any point
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.
4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.
5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

CC. Embedded Web Server

1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
2. The NSC shall be configurable to logging all Embedded Web Server access attempts
3. The NSC shall have the option to redirect HTTP based Embedded Web Server connections to secure, HTTPS connections.
4. The NSC shall authenticate and authorize all users connecting to the Embedded Web Server
5. The NSC shall provide to ability to configure an automatic logoff for Embedded Web Server users that have not had any activity for an adjustable time period.

DD. The NSC controller shall comply with the following regulatory certifications

1. CE – EN 61000-6-3
2. CE – EN 61000-6-2
3. CE – EN 61010-1
4. CE – EN 61326-1
5. FCC CFR 47 Part 15 Class A
6. RCM
7. RoHS 2011/65/EU
8. China RoHS SJ/T 11364-2014
9. UL916 Energy Management equipment

EE. HMI

1. The NSC shall have an option for a tablet display
2. The tablet display shall be an industrial grade Human Machine Interface (HMI) that can be locked to the building management application to create a dedicated tool for local operation and maintenance.

3. The tablet display shall provide an easy-to-use interface through which users and engineers can locally access NSC's
 4. The tablet display shall always start in a kiosk mode ensuring the end user can only use the device using the installed integration with the NSC.
 5. The tablet display shall always require a password on start up
 6. The tablet display shall require a password after a defined period of inactivity
 7. The tablet display shall support being handheld or being installed on a control cabinet.
 8. The tablet display user interface shall provide touchscreen navigation making it easy to operate and maintain the system.
 9. The tablet display shall support robust physical panel mounting mechanisms provided with the product.
 10. The tablet display shall have a screen size of 255mm or 10.1 inches
 11. The tablet display shall support a screen resolution of 1280 by 800 pixels
 12. The tablet display shall have a 16:10 aspect ratio
 13. The tablet display shall be based on the Android platform
 14. The tablet display shall have an IP54 rated frame that helps protect against dust and moisture.
 15. The tablet display shall be powered by a 24 VDC power supply
 16. The tablet display can be powered by a 24 VDC through the Y-shaped cable
 17. The tablet display shall be able to communicate with the NSC over a wired (USB) connection running BACnet IP over USB.
 18. The tablet display shall have an accessory Wi-Fi Module is an option instead of using USB for communication.
 - a. Through the Wi-Fi module, you can establish wireless communication between the tablet display and the NCS connected to a wireless access point.
 - b. The Wi-Fi module shall have an adhesive mount Wi-Fi antenna.
 - c. The Wi-Fi module shall be compliant with IEEE 802.11 b/g/n
 - d. The Wi-Fi module shall support enhanced wireless security using 64-bit and 128-bit WEP encryption
 19. The tablet display shall connect to the NSC using only secure, HTTPS connections via the WebStation functionality of the NSC
 20. The tablet display shall connect using a specific user and password combination defined as part of the NSC configuration
- FF. Zoning (software defined zoning)
1. It shall be possible for BMS software and Network Servers (NSCs) to support synchronized control of lights, blinds and HVAC across multiple floorplan scenarios.
 2. It shall be possible to create multiple synchronized control scenarios of lights/blinds/HVAC based to accommodate different floor plan scenarios.

3. It shall be possible to change synchronized control of lights/blinds/HVAC from one floorplan scenario to another manually or automatically.
4. It shall be possible to adapt synchronized controls of lights, blinds and HVAC to a different floorplan scenario using any device running a standard web browser.
5. It shall be possible for the administrator to manage user and group permissions to view / re-configure floor plan scenarios.

2.5 BACNET IP FIELDBUS CONTROLLERS

A. Controllers – BACnet/IP Protocol

1. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v12 or later) as specified BACnet Advanced Application Controller (B-AAC)
2. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:
 - a. All controllers shall be able to communicate peer-to-peer without the need for a NSC
 - b. Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

B. The BACnet/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and will support BACnet/IP communication protocols with the following configurations:

1. Supporting IPv4 addressing
2. Supporting Static IP setting, DHCP client and Auto-IP address acquisition
3. It shall be possible to disable Ethernet port 2

C. Topologies

1. BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/BMS of the point disruption has occurred.
2. BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.
 - a. In case of any disruption there shall be no communication interruption
 - b. In case of any disruption there shall be system alarms that will inform the operator of the disruption

D. Performance

1. Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
2. They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.

E. Programmability

1. The BACnet/IP Fieldbus controllers shall support both script programming language and graphical that will be consistent with the NSC.
2. The control program will reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs
3. All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
4. BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
5. BACnet/IP Fieldbus controllers shall support a dedicated communications port for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
6. BACnet/IP Fieldbus controllers (Excluding VAV) shall support an add-on display to supply and provide access in real-time for monitoring inputs and overriding of outputs
7. The override functionality must be supported by a dedicated processor to assure reliable operation (overriding of output)
8. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:
 - a. Control processes
 - b. Energy management applications
 - c. Alarm management
 - d. Historical/trend data
 - e. Maintenance support applications
 - f. Custom processes
 - g. Manal override monitoring
9. Each BACnet/IP Fieldbus controller shall support local trend data up to 2x the built-in I/O and at a minimum be capable of holding 5 days @ 15 min intervals locally.
10. The BACnet/IP Fieldbus controller analog or universal input shall use a 16 bit A/D converter.
11. The BACnet/IP Fieldbus controller analog or universal output shall use a 10 bit D/A converter.
12. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:
 - a. At minimum 8 and up to 20 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet.
 - 1) Universal Inputs – the following thermistors for use in the system without any external converters needed.
 - a) 10 kohm Type I (Continuum)
 - b) 10 kohm Type II (I/NET)
 - c) 10 kohm Type III (Satchwell)
 - d) 10 kohm Type IV (FD)
 - e) Linearized 10 kohm Type V (FD w/11k shunt)
 - f) Linearized 10 kohm (Satchwell)
 - g) 1.8 kohm (Xenta)
 - h) 1 kohm (Balco)
 - i) 20 kohm (Honeywell)
 - j) 2.2 kohm (Johnson)
 - k) PT100 (Siemens)

- 1) PT1000 (Sauter)
 - m) Ni1000 (Danfoss)
 - 2) Analog inputs
 - a) Current Input - 0-20 mA
 - b) Voltage Input 0-10 Vdc
 - 3) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 - 4) Digital outputs
 - 5) Analog outputs of 4-20 mA and/or 0-10 Vdc
13. Real Time Clock (RTC):
- a. Provide internal clocks for all BACnet Controllers (B-AAC) using BACnet time synchronization services.
 - 1) Automatically synchronize system clocks daily from an operator-designated controller.
 - 2) The system shall automatically adjust for daylight saving time.
 - b. Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month.
 - c. The RTC shall provide the following: time of day, day, month, year, and day of week.
 - d. The RTC date and time shall also be accurate up to 7 days, from when the BACnet/IP Fieldbus controller has lost power with no reliance on.
14. The BACnet/IP Fieldbus controller for Variable Air Volume (VAV) applications
- a. Multi-purpose and Room Purpose VAV controllers
 - 1) The BACnet/IP Fieldbus controller for VAV applications shall include a built-in 'flow thru' differential pressure transducer
 - 2) The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of $\pm 5\%$ at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within $\pm 5\%$ of setpoint at the specified minimum and maximum air flow parameters
 - 3) The BACnet/IP FieldBus controller for VAV applications shall support a dedicated commissioning tool for air flow balancing
 - 4) The BACnet/IP Fieldbus controller for VAV applications shall require no programming for air balancing algorithm
 - 5) All balancing parameters shall be synchronized in NSC
 - b. Room Purpose VAV controllers
 - 1) Room purpose controller expansion modules have the ability to interface with the following sensing elements.
 - a) People counting
 - b) Motion detecting
 - c) Luminosity and sound pressure level measurements
 - d) Bluetooth Low Energy base applications
 - e) Control of electric lights and window blinds
 - 2) Room purpose controller room bus supports up to 4 connected controller expansion modules with the following restrictions.
 - a) Maximum of one DALI light module

- b) Maximum of one SMI blind module
 - c) Maximum of two Multi-sensor or Insight-sensor devices
 - 3) Availability of 4 or 5 universal input/output controller models
 - 4) Support a Modbus RTU subnetwork
15. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection
 16. Power Requirements. 24VDC (21 to 33 VDC) and 24 VAC +/-20% with local transformer power
 17. Each BACnet/IP Fieldbus controller shall be accredited for smoke control and smoke management within a fully IP control solution

2.6 DDC SENSORS AND POINT HARDWARE

A. Temperature Sensors

1. Acceptable Manufacturers: Veris Industries, ACI Automation Components, Inc., Belimo
2. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of – 30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
3. Room Sensor: Standard space sensors shall be available in an [off white][black] enclosure made of high impact ABS plastic for mounting on a standard electrical box. Basis of Design: Veris TW Series
 - a. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
 - b. Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
4. Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet. Basis of Design: Veris TD Series
5. Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing. Basis of Design: Veris TA Series
6. Pipe Immersion Sensor: Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications. Basis of Design: Veris TI Series
7. Outside Air Sensor: Provide the sensing element on the building's north side. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F, Basis of Design: Veris TO Series
8. A pneumatic signal shall not be allowed for sensing temperature.

B. Air Pressure Transmitters.

1. Acceptable Manufacturers: Veris Industries, ACI Automation Components, Inc., Belimo
2. Transmitter shall have field selectable differential pressure and velocity modes.
3. Transmitter shall measure differential pressure in 14 ranges from 0.1 – 10” WC
4. Transmitter shall measure velocity in 16 ranges from 500 – 7000 ft/min.
5. Transmitter shall be +/- 1% accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation.
6. Transmitter shall be field configurable to mount on wall or duct with static probe
7. Transmitter shall be field selectable for Unidirectional or Bidirectional
8. Transmitter housing shall have IP65 and NEMA 4 environmental ratings.
9. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC linear.
10. Transmitter shall accept 12-30 VDC or 24 VAC supply power
11. Response time shall be field selectable T95 in 20 sec or T95 in 2 sec
12. Transmitter shall have an optional LCD display
13. Differential pressure mode units shall be field selectable for WC or PA.
14. Velocity mode units shall be field selectable for Ft/min or m/sec.
15. Transmitter shall have provision for zeroing by pushbutton or digital input.
16. Transmitter shall be available with a certification of NIST calibration.
17. Bluetooth option for communicating with Veris app available.
18. Basis of Design: Veris model PX3.

C. Liquid Differential Pressure Transmitters:

1. Acceptable Manufacturer: Veris Industries, ACI Automation Components, Inc.
2. Transmitter shall be microprocessor based
3. Transmitter shall use two independent gauge pressure sensors to measure and calculate differential pressure
4. Transmitter shall have 4 switch selectable ranges
5. Transmitter shall have test mode to produce full-scale output automatically.
6. Transmitter shall have provision for zeroing by pushbutton or digital input.
7. Transmitter shall have field selectable outputs of 0-5V, 0-10V, and 4-20mA.
8. Transmitter shall have field selectable electronic surge damping
9. Transmitter shall have an electronic port swap feature
10. Transmitter shall accept 12-30 VDC or 24 VAC supply power
11. Sensor shall be 17-4 PH stainless steel where it contacts the working fluid.
12. Performance:
 - a. Accuracy shall be $\pm 1\%$ F.S. and $\pm 2\%$ F.S. for lowest selectable range
 - b. Long term stability shall be $\pm 0.25\%$
 - c. Sensor temperature operating range shall be -4° to 185° F
 - d. Operating environment shall be 14° to 131° F; 10-90% RH noncondensing
 - e. Proof pressure shall be 2x max. F.S. range
 - f. Burst pressure shall be 5x max. F.S. range
13. Transmitter shall be encased in a NEMA 4 enclosure

14. Enclosure shall be white powder-coated aluminum
15. Transmitter shall be available with a certification of NIST calibration
16. Transmitter shall have option to be preinstalled on a bypass valve manifold
17. Transmitter shall have option for remote mounted sensors.
18. Basis of Design: Veris PW

D. Current Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris Industries & Functional Devices

E. Current Status Switches for Constant Load Devices

1. Acceptable Manufacturer: Veris Industries
2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
3. Visual LED indicator for status.
4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
5. Normally open current sensor output. 0.1A at 30 VAC/DC.
6. Basis of Design: Veris Model H608.

F. Current Status Switches for Constant Load Devices (Auto Calibration)

1. Acceptable Manufacturer: Veris Industries.
2. General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer
3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
4. Display: Backlit LCD; illuminates when monitored current exceeds 4.5A
5. Nominal Trip Point: $\pm 40\%$, $\pm 60\%$, or on/off (user selectable)
6. Normally open current sensor output. 0.1A at 30 VAC/DC.
7. Basis of Design: Veris Model H11D.

G. Water Control Valves

1. Ball Valves

½" to 2" Ball Valve

- 1) Forged brass body rated at no less than 600 psi, chrome plated brass ball with blowout proof stem or optional stainless steel ball with blowout proof stem,
- 2) Valves are to be in two-way and three-way configurations.
- 3) Connection: Female NPT end fittings, Teflon® PTFE seat, characterizing disc glass filled PEEK providing equal percentage flow curve on two-way valve.

- 4) Operating Temperature 20...250°F chilled or hot water with up to 60% glycol solution.
- 5) Two-way and Bypass port should be ANSI Class IV (0.01% of Cv) seat leakage.
- 6) Rangeability must be at least 300:1.
- 7) Tool-less actuator connection.
- 8) System Static Pressure Limit should be 600 psig (4137 Pa)
- 9) Acceptable Manufacturers: Schneider Electric, Belimo, Bray or approved equal.

H. Dampers

1. Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blade as required. Dampers are to be installed by the HVAC Contractor under the supervision of the BAS system supplier. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Contractor.
2. Damper frames are to be constructed of 13 gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel to eliminate noise as friction. Compressible spring stainless steel side seals and acetyl or bronze bearings shall also be provided.
3. Damper blade width shall not exceed eight inches. Seals and 3/8 inch square steel zinc plated pins are required. Blade rotation is to be parallel or opposed as shown on the schedules.
4. For outdoor air and high performance applications, control dampers will meet or exceed the UL Class I leakage rating.
5. Control and smoke dampers shall be Ruskin, or approved equal.
6. Provide opposed blade dampers for modulating applications and parallel blade for two position control.

I. Damper Actuators

1. Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque.
2. Direct-coupled damper actuators must have a five-year warrantee.
3. Size for torque required for damper seal at maximum design conditions and valve close-off pressure for system design.
4. Direct-coupled damper actuators should accommodate 3/8", 1/2" 1.05" round or 3/8"...1/2" and 3/4" square damper shafts.
5. Actuator operating temperature minimum requirements: 44, 88 and 133 lb.-in. are -25°F...130°F (-32°C...55°C). The 30, 35, 60, 150 and 300 lb.-in. are -25°...140°F (-30°C... 60 °C). The 270 are -22°...122°F (-30°C... 50 °C).
6. Overload protected electronically throughout rotation except for selected Floating actuators the have a mechanical clutch.
7. Spring Return Actuators: Mechanical fail safe shall incorporate a spring-return mechanism.
8. Non-Spring Return Actuators shall stay in the position last commended by the controller with an external manual gear release to allow positioning when not powered.
9. Power Requirements: 24Vac/dc [120Vac][230Vac]
10. Proportional Actuators controller input range from 0...10 Vdc, 2...10 Vdc or 4...20 mA models.
11. Housing: Minimum requirement NEMA type 2 with NEMA type 4 available for applications requiring higher ratings.

12. Actuators with a microprocessor should not be able to be modified by an outside source (cracked or hacked).
13. Actuators of 133 and 270 lb.-in. of torque or more should be able to be tandem mount or “gang” mount.
14. Agency Listings: ISO 9001, cULus, CE and CSA
15. Basis of Design: Schneider Electric, Belimo, or approved equal.

J. Airflow Measuring Stations

1. Airflow measurement devices 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.
2. Thermal dispersion devices that indirectly heat a thermistor are not acceptable.
3. Acceptable Manufacturers: Ebtron, Inc. model GTx116-P+

PART 3 - EXECUTION

3.1 GENERAL

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section 23 00 00 and Drawings.
- B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- D. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
- E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer’s written instructions and recommendations, and as indicated on the Drawings.
- F. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.
- G. Demolition
 1. Remove controls which do not remain as part of the building automation system, all associated abandoned wiring and conduit, and all associated pneumatic tubing. The Owner will inform the Contractor of any equipment which is to be removed that will remain the property of the Owner. All other equipment which is removed will be disposed of by the Contractor.
- H. Access to Site
 1. Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner’s Representative.

I. Code Compliance

1. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications in Division 17 and Division 16, wiring requirements of Division 17 will prevail for work specified in Division 17.

J. Cleanup

1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.2 SYSTEM ACCEPTANCE TESTING

- A. All application software will be verified and compared against the sequences of operation.
- B. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.
- C. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.
- D. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.
- E. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

3.3 INSTALLATION

A. Hardware Installation Practices for Wiring

1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
2. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
4. Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.
5. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.

6. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
7. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
9. Wire will not be allowed to run across telephone equipment areas.
10. Provide fire caulking at all rated penetrations.

B. Installation Practices for Field Devices

1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
3. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
5. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
6. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.

C. Wiring, Conduit, and Cable

1. All wire will be copper and meet the minimum wire size and insulation class listed below:
 - a. Power - 12 Gauge - 600 Volt
 - b. Class One - 14 Gauge Std. - 600 Volt
 - c. Class Two - 18 Gauge Std. - 300 Volt
 - d. Class Three - 18 Gauge Std. - 300 Volt
 - e. Communications - Per Mfr.
2. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.
3. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.
4. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.
5. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.
6. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal

four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

7. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.
8. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.
9. Only glass fiber is acceptable, no plastic.
10. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS system supplier shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

D. Enclosures

1. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
2. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.
3. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.
4. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
5. All outside mounted enclosures shall meet the NEMA-4 rating.
6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

E. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
3. Junction box covers will be marked to indicate that they are a part of the BAS system.
4. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.
5. All I/O field devices inside FIP's shall be labeled.

F. Existing Controls.

1. Existing controls which are to be reused must each be tested and calibrated for proper operation. Existing controls which are to be reused and are found to be defective requiring replacement, will be noted to the Owner. The Owner will be responsible for all material and labor costs associated with their repair.

G. Location

1. The location of sensors is per mechanical and architectural drawings.

2. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
3. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
4. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

H. Software Installation

1. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

3.4 TRAINING

- A. The BAS system supplier shall provide both on-site and classroom training to the Owner's representative and maintenance personnel per the following description:
- B. On-site training shall consist of a minimum of (8) hours of hands-on instruction geared at the operation and maintenance of the systems. The curriculum shall include
 1. System Overview
 2. System Software and Operation
 3. System access
 4. Software features overview
 5. Changing setpoints and other attributes
 6. Scheduling
 7. Editing programmed variables
 8. Displaying color graphics
 9. Running reports
 10. Workstation maintenance
 11. Viewing application programming
 12. Operational sequences including start-up, shutdown, adjusting and balancing.
 13. Equipment maintenance
- C. Factory, classroom training will include a minimum of (2) training reservations for a 3 day course with material covering workstation operation tuition free with travel expense responsibility of the owner. The option for 2-3 weeks of system engineering and controller programming shall be possible if necessary and desired.

3.5 DATABASE CONFIGURATION.

- A. The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

3.6 COLOR GRAPHIC DISPLAYS.

- A. Unless otherwise directed by the owner, the Contractor will provide color graphic displays as depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the owner.

3.7 POINT TO POINT CHECKOUT.

- A. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the owner or owner's representative.
- B. In case of wireless devices, the signal strength recorded during checkout shall be reported.

3.8 CONTROLLER AND WORKSTATION CHECKOUT.

- A. A field checkout of all controllers and front end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner's representative by the completion of the project.

3.9 DOCUMENTATION

- A. As built software documentation will include the following:
 - 1. Descriptive point lists
 - 2. Application program listing
 - 3. Application programs with comments.
 - 4. Printouts of all reports.
 - 5. Alarm list.
 - 6. Printouts of all graphics
 - 7. Commissioning and System Startup
 - 8. An electronic copy of all databases, configuration files, or any type of files created specifically for each system.

END OF SECTION 23 09 23

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes 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.
- B. Related Sections include the following:
 - 1. Section 232123 "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.
- B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 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.

1.5 ACTION 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control test reports.
- D. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.
- B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. 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.
- D. 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.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. 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. Cerro
 - c. S. P. Fittings; a division of Star Pipe Products.
 - d. Victaulic Company.
 - e. Mueller
- E. Wrought-Copper Unions: ASME B16.22.
- F. Press fittings:
 - 1. Alloy: Copper alloy - UNS C12200; Zero Lead silicon bronze alloy - C87710 (cast) or C87700 (machined).
 - 2. Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME B16.22 or ASME B16.26.
 - 3. Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM.

4. EPDM (Ethylene Propylene Diene Monomer) is a synthetically manufactured and peroxidically cured all purpose elastomer. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have the Smart Connect technology design (leakage path). In fittings ½" to 4" dimensions the Smart Connect technology assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
5. E. Threaded Fittings: Pipe Threads shall conform to ASME B1.20.1.

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-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. 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.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Victaulic Company.
 2. 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, 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.
 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

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. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
 1. CPVC Piping: ASTM F 493.
 - a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Solvent cement and adhesive primer 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. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Solvent cement and adhesive primer 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."

- H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.

 2. CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

- B. Plastic-to-Metal Transition Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - d. NIBCO INC.

 2. MSS SP-107, CPVC and PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

- B. Dielectric Flanges:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 deg F
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 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.
- D. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca, Inc.
 - 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 at 225 deg F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

2.7 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC."
- C. Calibrated Balancing Valves and Automatic Flow-Control Valves shall not be used on equipment where pressure independent control valves are used.
- D. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum 125 psig.
 - 10. Maximum Operating Temperature: 250 deg F.
- E. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
 - 2. Body: Cast-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.

7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

2.8 AIR CONTROL DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amtrol, Inc.
 2. Armstrong Pumps, Inc.
 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 4. Taco.
- C. Manual Air (coin) Vents:
 1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or square drive key.
 4. Inlet Connection: NPS 1/8.
 5. Discharge Connection: NPS 1/8.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 deg F.
- D. Automatic Air Vents:
 1. Body: Bronze or cast iron.
 2. Internal Parts: Nonferrous.
 3. Operator: Noncorrosive metal float.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/4.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 240 deg F.
- E. Bladder-Type Expansion Tanks:
 1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
 3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
- F. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

G. 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 175 psig.
3. Maximum Operating Temperature: Up to 300 deg F.

H. Air Purgers:

1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: 150 psig.
3. Maximum Operating Temperature: 250 deg F.

2.9 CHEMICAL TREATMENT

- A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
- B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.10 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- C. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
 2. End Connections: Grooved ends.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 4. CWP Rating: 750 psig.
- D. 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.
- E. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
 2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
 3. Performance: Capable of misalignment.
 4. CWP Rating: 150 psig.
 5. Maximum Operating Temperature: 250 deg F.
- F. Expansion fittings are specified in Section 230516 "Expansion Fittings and Loops for HVAC Piping."

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. Optional Viega Pro-Press system may be used.
 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

- 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.
- C. Makeup-water piping installed aboveground shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- E. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- F. 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 K, annealed-temper copper tubing with soldered or flared joints.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. 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.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 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. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. 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.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 230516 "Expansion Fittings and Loops for HVAC Piping."

- U. Identify piping as specified in Section 230553 "Identification for HVAC Piping and Equipment."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- 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.
 - 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 - 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 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. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. 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.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Nonpressure Piping: Join according to ASTM D 2855.

- H. 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. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- I. Press connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. 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.
- G. Install expansion tanks above 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.
- H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 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.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
 - 1. pH: 9.0 to 10.5.
 - 2. "P" Alkalinity: 100 to 500 ppm
 - 3. Boron: 100 to 200 ppm.
 - 4. Chemical Oxygen Demand: Maximum 100 ppm. Modify this value if closed system contains glycol.
 - 5. Corrosion Inhibitor:
 - a. Sodium Nitrate: 1000 to 1500 ppm.
 - b. Molybdate: 200 to 300 ppm.
 - c. Chromate: 200 to 300 ppm.
 - d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
 - e. Chromate Plus Molybdate: 50 to 100 ppm each.
 - 6. Soluble Copper: Maximum 0.20 ppm.
 - 7. Tolyriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
 - 8. Total Suspended Solids: Maximum 10 ppm.
 - 9. Ammonia: Maximum 20 ppm.
 - 10. Free Caustic Alkalinity: Maximum 20 ppm.
 - 11. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maximum 1000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maximum 100 organisms/ml.
 - c. Nitrate Reducers: 100 organisms/ml.
 - d. Sulfate Reducers: Maximum 0 organisms/ml.
 - e. Iron Bacteria: Maximum 0 organisms/ml.
- B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- D. Fill systems indicated to have antifreeze or glycol solutions with the following concentrations:

1. Hot-Water Heating Piping: Minimum 35 percent propylene glycol.

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 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 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. 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.

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Academic Innovation Hub
Work Force Development Training
Niagara University

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END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air-control devices.
 - 3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 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.

2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230923.11 "Control Valves."Section 15901 "Control Valves."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 2. Ball: Brass or stainless steel.
 3. Plug: Resin.
 4. Seat: PTFE.
 5. End Connections: Threaded or socket.
 6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 7. Handle Style: Lever, with memory stop to retain set position.
 8. CWP Rating: Minimum 125 psig
 9. Maximum Operating Temperature: 250 deg F.
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
 1. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 2. Ball: Brass or stainless steel.
 3. Stem Seals: EPDM O-rings.
 4. Disc: Glass and carbon-filled PTFE.
 5. Seat: PTFE.
 6. End Connections: Flanged or grooved.

7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum 125 psig .
 10. Maximum Operating Temperature: 250 deg F.
- E. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
1. Body: Bronze or brass.
 2. Disc: Glass and carbon-filled PTFE.
 3. Seat: Brass.
 4. Stem Seals: EPDM O-rings.
 5. Diaphragm: EPT.
 6. Low inlet-pressure check valve.
 7. Inlet Strainer: <Insert materials>, removable without system shutdown.
 8. Valve Seat and Stem: Noncorrosive.
 9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.3 AIR-CONTROL DEVICES

- A. 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
- B. Automatic Air Vents:
1. Body: Bronze or cast iron.
 2. Internal Parts: Nonferrous.
 3. Operator: Noncorrosive metal float.
 4. Inlet Connection: NPS 1/2
 5. Discharge Connection: NPS 1/4
 6. CWP Rating: 150 psig
 7. Maximum Operating Temperature: 240 deg F
- C. Bladder-Type Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
 3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
- D. Combination Air Eliminator and Dirt Separators:
1. Full flow coalescing type combination air eliminator and dirt separator shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with

- ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles.
2. Selection shall be based upon system flow with pipe size as a minimum. In no case shall entering velocity exceed 10 feet per second.
 3. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must be fabricated by the manufacturer and consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.
 4. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
 5. Units shall include a side tap valve to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
 6. Unit shall be manufactured with a removable lower head for internal inspection if so noted on the drawings and schedule.
 7. Unit shall be manufactured with internal magnet(s), if so noted on the drawings and schedule.
 8. Magnet(s) shall be positioned at the centerline of the inlet and outlet nozzles for maximum effectiveness during normal operation.
 9. Units sized 2" through 6" shall have one magnet
 10. Magnet(s) shall be removable from the vessel.
 11. Magnet(s) shall be made of high-strength Neodymium alloy.
 12. Magnet(s) shall be disengaged for dirt blowdown by means of a spring-loaded pull, without requiring removal of the magnet from the vessel or isolating the unit from the system.
 13. Magnet option shall be provided with 360 deg. rotatable blow down valve.
 14. Size: Match system flow capacity.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install throttling-duty valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. 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; 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.

- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install expansion tanks above 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.
- G. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 1. Separately coupled, base-mounted, end-suction centrifugal pumps.
 2. Close-coupled, in-line centrifugal pumps.
 3. ECM Motor Wet-rotor pumps.
 4. Automatic condensate pumps units.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pump. 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: For each pump.
 1. Show pump layout and connections.
 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 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. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. ITT Corporation; Bell & Gossett.
 2. TACO Incorporated.
 3. Armstrong Pumps Inc.
 4. Grundfos.
- 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 companion-flange 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 Viton bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Pump Bearings: Permanently lubricated ball bearings.
- D. Shaft Coupling: Axially split spacer coupling.
- E. Motor: Single speed and rigidly mounted to pump casing with lifting eyebolt and supporting lugs in motor enclosure.
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."
 3. Enclosure: Totally enclosed, fan cooled.
 4. Enclosure Materials: Cast iron or Rolled steel.
- F. Motor Bearings: Permanently lubricated ball bearings.

- G. Efficiency: Premium efficiency.
- H. NEMA Design: Nema1.
- I. Service Factor: 1.15.

2.2 ECM WET-ROTOR PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. ITT Corporation; Bell & Gossett.
 - 2. TACO Incorporated.
 - 3. Grundfos Pumps Corporation.
 - 4. Armstrong Pumps Inc.
- B. Description: Factory-assembled and -tested, wet-rotor pump.
- C. Pump Construction:
 - 1. Body: 100 percent lead-free bronze for domestic water or Cast iron for heating systems.
 - 2. Impeller: Engineered composite (poly).
 - 3. Pump Shaft: Stainless Steel.
 - 4. Bearings. Carbon sleeve bearing type.
 - 5. Connection: Flanged
- D. Motor: Shall be synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Conventional induction motors will not be acceptable.
 - 1. Each motor shall have an integrated Variable Frequency Drive tested as one unit from the manufacturer.
 - 2. Integrated motor protection shall be verified by UL to protect the pump against over/under voltage, over temperature of motor and/or electronics, over current, locked rotor and dry run (no load condition).
 - 3. Integrated VFD shall allow BMS communication via BACnet, 0 – 10 volt DC control of speed or head setpoint, external minimum speed, external off, dual pump communication and pump operation status.

2.3 AUTOMATIC CONDENSATE PUMP UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Beckett Corporation.
 - 2. Hartell Pumps Div.; Milton Roy Co.
 - 3. Little Giant Pump Co.
 - 4. Mepco, LLC.
- B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch-minimum, electrical power cord with plug.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

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 the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4 and HI 2.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

- E. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct bases to withstand, without damage to equipment, seismic force required by code.
 - 3. Construct concrete bases 4 inches high and extend base not less than 6 inches in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.
 - 4. Minimum Compressive Strength: 3000 psi at 28 days.
- F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.

3.3 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.

3.4 CONNECTIONS

- A. Where installing piping adjacent to pump, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- D. Install triple-duty valve on discharge side of pumps.
- E. Install Y-type strainer (for inline pumps) or suction diffuser (for base-mounted pumps) and shutoff valve on suction side of pumps.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

- H. Install check valve and gate or ball valve on each condensate pump unit discharge.
- 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."

3.5 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 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 refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
 - 3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.8 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L, ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Brazing Filler Metals: AWS A5.8.
- D. 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 VALVES AND SPECIALTIES

A. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

B. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

C. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Rated Flow: Sized per circuit tonnage.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

D. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.

2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

- B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 (DN 40) 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: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and 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 or packed-angle valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. 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.
- G. 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.
- H. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- I. Install receivers sized to accommodate pump-down charge.
- J. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230900 "Instrumentation and Control for HVAC".
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.

- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. 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 BA_g, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.

4. Spring hangers to support vertical runs.
 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
1. 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 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following HVAC water-treatment systems:
 - 1. Manual and automatic chemical-feed equipment and controls.
 - 2. Chemical treatment test equipment.
 - 3. Chemicals.
 - 4. Water filtration equipment.

1.3 DEFINITIONS

- A. EEPROM: Electrically erasable, programmable read-only memory.
- B. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
 - 1. Chemical test equipment.
 - 2. Chemical material safety data sheets.
 - 3. Multimedia filters.
 - 4. Replaceable bag- or cartridge-type filters.
- B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems.
- C.
 - 1. Include plans, elevations, sections, and attachment details.
 - 1. Include diagrams for power and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For glycol feed units and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- B. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- C. Field quality-control reports.
- D. 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 "Performance Requirements" Article.
 2. Water Analysis: Illustrate water quality available at Project site.
 3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sensors, injection pumps, and controllers 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.

PART 2 - PRODUCTS

2.1 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 to 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. Water treatment for the evaporative chiller shall be provided by the chiller manufacturer.

2.2 CHEMICAL-FEED EQUIPMENT

- A. Bypass Filter Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch (89-mm) fill opening in the top, and NPS 3/4 (DN 20) bottom inlet and top side outlet. Provide quarter- turn or threaded fill cap with gasket seal and diaphragm arranged to lock the top onto the feeder when exposed to system pressure in the vessel. Provide a NPS 3/4 IN (DN 20) quarter-turn valve on inlet and outlet. Unit shall have filter bag holder basket with a 50 Micron startup filter. Provide 20 Micron and (3) 5 Micron filter bags. Unit based on Neptune Model VTF
1. Capacity: **2.5 gal. (7.6 L)**.
 2. Minimum Working Pressure: **125 psig (860 kPa)**.
 - 3.

2.3 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. Install chemical application equipment on concrete bases level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
- B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. See Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install water-testing equipment on wall near water-chemical-application equipment.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Hydronic Systems Preparation:
1. Clean and flush piping system, remove, clean and replace strainer screens once the system water is clear.
 2. Water flush applies to the following systems:

- a. Heating Water
 3. Clean and flush piping system, remove, clean and replace strainer screens once the system water is clear.
- G. Chemical Cleaning:
1. Refill the system with water and allow for 10 volume percent of pre-cleaner for the removal of scale, oils and other extraneous materials. Add the required amount of cleaner and circulate for 6 to 8 hours at 150 degrees F, or 12 hours if less than 90 degrees Fahrenheit.
 2. The system cleaner shall be INTERCLEAN MC-1 by Interstate Chemical Co. or approved equal.
 3. Drain the system after the required circulation period as quickly as possible, this will prevent settling of foulants. Run circulating pumps and flush with clean water until the discharge water is clear
 4. When system water is clear, remove, clean and replace all strainers.
 5. Fill the system with the approved system inhibitor, all air vents should be opened during the filling process to ensure that the air is purged from the system. Once the system is full, all air vents should be closed.

3.3 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 equipment, allow space for 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 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."
- E. See Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.
- F. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.
- G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following 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. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC system's startup procedures.
 - 4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 - 5. 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.
 - 6. 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.
 - 7. 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.
 - 8. Repair leaks and defects with new materials and retest piping until no leaks exist.
- C. Equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. At eight-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.
- F. Comply with ASTM D 3370 and with the following standards:
 - 1. Silica: ASTM D 859.
 - 2. Steam System: ASTM D 1066.
 - 3. Acidity and Alkalinity: ASTM D 1067.
 - 4. Iron: ASTM D 1068.
 - 5. Water Hardness: ASTM D 1126.

3.5 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide glycol analysis at 6 and 12 month intervals from date of substantial completion. Provide written report of results. Contractor shall provide recommended corrective action to maintain water and glycol quality in system.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 232500

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:
1. Rectangular ducts and fittings.
 2. Single-wall, round spiral-seam ducts and formed fittings.
 3. Sheet metal materials.
 4. Duct liner.
 5. Sealants and gaskets.
 6. Hangers and supports.
- B. Related Sections include the following:
1. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 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. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

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 product indicated.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. 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.
 - 5. Design Calculations: Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.

f. Perimeter moldings.

B. Welding certificates.

1.6 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 D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 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 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. Approved Manufacturers:
 - 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.
 2. Round ducts exposed to view shall be spiral pipe lock seam.
- 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.
 2. Round ducts exposed to view shall be spiral pipe lock seam.
- 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. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 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."
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.
- B. As indicated on drawings ductwork shall be insulated with duct liner meeting the requirements of ASTM C1071 and the additional following requirements.
1. Type I - Blanket material, in roll form:
 - a. Have a maximum thermal conductivity(k-value), at 75°F mean temperature, of 0.24 Btu. in/hr./sq.ft./°F Sound absorption coefficients and NRC shall meet or exceed the following when tested in accordance with ASTM C 423 using an "A" mounting.

Thickness	Type	Absorption Coefficients @ Octave Band Frequencies (Hz)							NRC
		125	250	500	1000	2000	4000		
1/2"	200	.05	.15	.35	.61	.75	.88	.45	
1"	150	.06	.27	.66	.87	.98	.99	.70	
1-1/2"	150	.18	.53	.97	1.06	1.06	.90	.90	

2" 150 .24 .74 1.12 1.11 1.07 1.08 1.00

2. Type II - Board in sheet form:
 - a. Have a maximum thermal conductivity at 75°F (24°C) mean temperature, of 0.23 Btu. in/hr./sq.ft./°F
 - b. Sound absorption coefficients and NRC shall meet or exceed the following when tested in accordance with ASTM C 423 using an "A" mounting:

	<u>Absorption Coefficients @ Octave Band Frequencies (Hz)</u>						
<u>Thickness</u>	<u>125</u>	<u>250</u>	<u>500</u>	<u>1000</u>	<u>2000</u>	<u>4000</u>	<u>NRC</u>
1"	.07	.28	.72	.90	.93	.93	.70
1-1/2"	.13	.49	.89	.95	.92	.93	.80
2"	.17	.76	1.05	1.02	.95	.96	.95

3. Antimicrobial coating in first subparagraph below is an optional feature for duct liner.
4. Have a potential heat value not exceeding 3500 btu/lb when tested in accordance with NFPA 259 and meeting the classification of "Limited Combustible" as defined by NFPA 90A.
5. Maximum rated velocity not less than 5000 FPM when tested in accordance with ASTM C 1071.
6. 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.
 - a. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C 1138, G 21 and G22.
7. Solvent or Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
8. Thickness: Provide 1-1/2" duct liner where shown on drawings.

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick stainless 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. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 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. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts 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 fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. 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":

- 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 2. All Ducts: Seal Class A.

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, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
- 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. Do not attach to plain metal deck systems.
- G. Cable hangers not permitted.

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 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. Supply Ducts:
 - a. Pressure Class: Positive 2-inch wg
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Return Ducts:
 - a. Pressure Class: Positive or negative 2-inch wg
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- D. Exhaust Ducts:
 - 1. Ducts Connected to general exhaust and air handling units:
 - a. Pressure Class: Positive or negative 2-inch wg
 - b. SMACNA Leakage Class for Rectangular: 12
 - c. SMACNA Leakage Class for Round and Flat Oval: 3.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - a. Pressure Class: Positive or negative 2-inch wg
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 3.
- F. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. PVC-Coated Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 3. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 4. Aluminum Ducts: Aluminum.
- G. Liner (where indicated):
 - 1. Supply Air Ducts: Fibrous glass, Type I, 1 inches thick.
 - 2. Return Air Ducts: Fibrous glass, Type I, 1 inches thick.

3. Supply Fan Plenums: Fibrous glass, Type II, 1 inches thick.
4. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 1 inches thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1500 fpm or lower:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) 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."
 - b. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) 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. 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."
3. 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 1500 fpm or lower: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 2) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 3) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. 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: High Efficiency Takeoff with square to round transition with 1" mounting flange and gasket. 26 Gauge minimum.
2. Round: 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 or 45 deg. boot tap.
 - b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233116 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Underground Ducts
- B. Related Requirements:
 - 1. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Underground Ducts
 - 2. Sealants and Gaskets
- B. Shop Drawings: For underground ducts. Include scale 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. Burial and supports, including methods for duct burial and internal and external bracing if recommended by the manufacturer.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 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. SMACNA's "Thermoset FRP Duct Construction Manual."
3. Static-Pressure Classes:
 - a. Supply Ducts (except in Mechanical Rooms): **2-inch wg (500 Pa)**.
 - b. Return and 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. NFPA Compliance:
 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- E. All ductwork shall be constructed to SMANCA requirements for 2" W.C.

2.2 UNDERGROUND DUCTS AND FITTINGS

- A. ACCEPTABLE MANUFACTURERS:
 1. The BlueDuct® by AQC Industries, Roseville, MN 55126, (877-783-1520).
www.aqcind.com and e-mail: team@aqcind.com
- B. UNDERGROUND DUCT SYSTEM
 1. Complete duct system (including inlet plenums, round duct, run-outs, diffuser boots, etc.) must be from one manufacturer and be of the same material, construction and connection method throughout. Field made duct components are NOT acceptable.
 2. Provide elbows, ducts, diffuser boxes, plenums, clamp & gaskets, boots, saddle registers and caulk as required by drawings for underground installation.
 3. Unless otherwise noted, all duct and fittings shall be constructed per SMACNA's Duct Construction Standards to withstand +10" w.g. and -2" w.g.
 4. Ductwork shall be closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTM-D2412. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88). Ductwork shall not rust or crack under external stress or strain. Ductwork shall have integral R-10 equivalent thermal insulation value, without the use of external insulation, per NSF's P374 Protocol and verified by a NSF Thermal Testing Report.
 5. All joints shall be sealed via gasket or bolts and sealant.
 6. Clamps and gaskets shall be used on ductwork without flanges. Clamps shall be polyethylene with stainless steel plates and stainless-steel screws. Gaskets shall comprise of ¼" thick butyl rubber sealant tape that is water and UV resistant and shall not stain. Gaskets shall comply with ASTM-E84 for flame and smoke spread.
 7. Flanged joints and duct branches shall use a co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.
 8. Assembled ductwork shall be able to maintain pressure with no leakage.

9. Duct system shall be installed by an AQC Industries' trained installer.
10. PVC coated galvanized steel ductwork shall NOT be acceptable.
11. Duct system performance shall exceed SMACNA's Leakage Class 1 requirements at the system design static pressure.
12. Duct system shall carry a 10-year Limited Warranty.

2.3 THERMOSET FRP DUCTS AND FITTINGS (ALTERNATE MANUFACTURERS)

A. ACCEPTABLE MANUFACTURERS:

1. Monoxivent
2. Viron

B. Duct and Fittings:

1. Thermoset FRP Resin: 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.
2. Inner Liner: FSK liner rated by an NRTL to comply with UL 181, Class 1.
3. Round Duct: ASTM D 2996, Type I, Grade 2, Class E, filament-wound duct, minimum **0.125-inch (3.2-mm)** wall thickness, with tapered bell-and-spigot ends for adhesive joints or with plain ends with couplings.
4. Round Fittings: Compression or spray-up/contact, molded of same material, pressure class, and joining method as duct.
5. Rectangular Fittings: Minimum **0.125-inch- (3.2-mm-)** thick, flat sheet with fiberglass roving and resin-reinforced joints and seams.
6. Double-Wall Insulated Duct: Inner and outer duct complying with requirements in "Round Duct" Subparagraph. Polyurethane foam or isocyanurate insulation with maximum thermal conductivity of **0.14 Btu x in./h x sq. ft. x deg F (0.020 W/m x K)** at **75 deg F (24 deg C)** mean temperature.

C. Joining Materials: Roving and polyester resin.

1. As recommended by manufacturer of ductwork.

D. Fabrication:

1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, and access doors and panels according to SMACNA's "Thermoset FRP Duct Construction Manual," Ch. 7, "Requirements."
2. 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.

E. Drains: Formed drain pockets with a minimum of **NPS 1 (DN 25)** threaded pipe connections.

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 heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- J. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation
- K. 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.
- L. Branch Connections: Use lateral or conical branch connections.
- M. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- N. Install thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual."
- O. Install PVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual."

3.2 UNDERGROUND DUCT INSTALLATION

A. Installation

1. Follow The BlueDuct Installation Instructions provided by AQC Industries. It is strongly recommended to complete installation training provided by AQC Industries prior to installation
2. Excavate a trench evenly as per The Blue Duct Installation Instructions. No bedding is required except for cases of bedrock or clay where sand or light aggregate may be used.
3. Backfill material must consist of pea gravel or dry silica sand.
4. The sealant and gasket material provided by AQC Industries must be used as directed. The use of non-approved sealant or gasket will void warranty.

B. Testing

1. The complete underground duct system shall be tested for leakage after final assembly.
2. Follow SMACNA air duct leakage test standard.
3. Allow 24 hours for The BlueDuct sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions.

C. Cleaning

1. Remove dust and debris from ductwork prior to occupancy.

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. Supply, return and exhaust ducts with a Pressure Class of **2-Inch wg (500 Pa)** or Higher: Test representative duct sections, totaling no less than **100** 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. Test protocols shall be performed according to NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems," "Section 5 - Cleanliness Verification and Documentation."
2. Visually inspect duct system to ensure that no visible contaminants are present.
3. Test sections of fibrous-glass duct system chosen randomly by Owner for cleanliness according to "Method 2 Protocol."
4. 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 SCHEDULE

A. Underground Ducts:

1. Provide suitable external surface protection as recommended by manufacturer.
2. Thermoset FRP Round Ducts and Fittings:
 - a. Double wall.
 - b. Insulation Thickness: **1 inch (25 mm)**.
3. PVC Round Ducts and Fittings:
 - a. BlueDuct as manufactured by AQC Industries.

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. Manual volume dampers.
 - 2. Remote manual damper operators.
 - 3. Control dampers.
 - 4. Fire dampers.
 - 5. Flange connectors.
 - 6. Turning vanes.
 - 7. Duct-mounted access doors.
 - 8. Flexible connectors.
 - 9. Flexible ducts.
 - 10. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

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: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 5 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 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Pottorff.
 - f. Ruskin Company.
 - g. Greenheck Company
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Frame: Hat-shaped, 0.05-inch-thick stainless steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Stainless-steel, 0.064 inch thick.
 - 6. Blade Axles: Stainless steel.
 - 7. Bearings:
 - a. Oil-impregnated stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Galvanized steel.

2.4 REMOTE MANUAL DAMPER OPERATORS

- A. Damper controller and cable shall be concealed above the ceiling. Cable to consist of Bowden cable .054" stainless steel control wire with a tensile strength of 260,000 lbs. that is

encapsulated in 1/16" flexible galvanized spiral wire sheath. Control kit shall consist of 2-5/8" diameter die cast aluminum housing with 3" diameter white primer powder coated cover, and 14 gauge steel rack and pinion gear drive capable of delivering 35 in. lbs. of push / pull torque that converts rotary motion to push-pull motion. Control shaft shall be D-style flatted 1/4" diameter with 265-degree rotation providing graduations for positive locking and control, and 1-1/2" linear travel capability. Control kit is designed to be imbedded in the ceiling flush with the finished surface. Control kit shall be manually operated using Young Regulator Model 030 wrench. Control kit shall be Young Regulator Model 270-301 or prior approved equivalent.

2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Arrow United Industries; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
 - 6. NCA Manufacturing, Inc.
 - 7. Pottorff.
 - 8. Prefco; Perfect Air Control, Inc.
 - 9. Ruskin Company.
 - 10. Vent Products Company, Inc.
 - 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- C. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- D. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- E. Fire Rating: 1-1/2 hours.
- F. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream]; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- G. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.05 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.
- H. Mounting Orientation: Vertical or horizontal as indicated.

- I. 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.
- J. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- K. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.

2.6 FLANGE CONNECTORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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.

2.7 TURNING VANES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.8 DUCT-MOUNTED ACCESS DOORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of 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. Ventfabrics, Inc.
 10. 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-inch butt 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.

2.9 DUCT ACCESS PANEL ASSEMBLIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.

- C. Panel and Frame: Minimum thickness 0.0528-inch 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.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.10 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor 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. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Non-Clamp Connectors: Adhesive plus sheet metal screws.

2.12 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. 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. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be 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.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream from turning vanes.
 - 9. Control devices requiring inspection.
 - 10. Elsewhere as indicated.
- 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. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Adjustable bar registers and grilles.
4. Fixed face registers and grilles.
5. Linear slot diffusers.

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 and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 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 each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. Nailor Industries Inc.

- e. Price Industries.
 - f. Titus.
- 2. Basis of Design – Priced SCD
 - 3. Devices shall be specifically designed for variable-air-volume flows.
 - 4. Material: Steel.
 - 5. Finish: Baked enamel, white.
 - 6. Face Size: 24 by 24 inches or 12 x 12 with panel where indicated on drawings.
 - 7. Face Style: Three cone.
 - 8. Mounting: T-bar.
 - 9. Pattern: Fixed.
 - 10. Dampers: Radial opposed blade.
 - 11. Accessories:
 - a. Equalizing grid.
 - b. Operating rod extension.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Register:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. Nailor Industries Inc.
 - e. Price Industries.
 - f. Titus.
- 2. Basis of design: Price Model 520
- 3. Material: Steel.
- 4. Finish: Baked enamel, white.
- 5. Face Blade Arrangement: Refer to schedule on drawings.
- 6. Rear-Blade Arrangement: Refer to schedule on drawings.
- 7. Frame: 1-1/4 inches wide.
- 8. Mounting: Refer to plans.
- 9. Damper Type: Adjustable opposed blade.

B. Fixed Face Register:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. Nailor Industries Inc.
 - e. Price Industries.

- f. Titus.
 - 2. Material: Steel.
 - 3. Finish: Baked enamel, white.
 - 4. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
 - 5. Core Construction: Removable.
 - 6. Frame: 1-1/4 inches wide.
 - 7. Mounting: Refer to plans.
 - 8. Damper Type: Adjustable opposed blade.
- C. Fixed Face Grille:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. Nailor Industries Inc.
 - e. Price Industries.
 - f. Titus.
 - 2. Basis of Design: Price 630
 - 3. Material: Aluminum.
 - 4. Finish: Baked enamel, white.
 - 5. Face Arrangement: 45 degree deflection fixed louver type, with one set of blades with 3/4 inch on center blade spacing [Model 630]
 - 6. Frame: 1-1/4 inches wide.
 - 7. Mounting: Refer to plans.
- D. Linear Slot Diffusers
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Krueger.
 - d. Nailor Industries Inc.
 - e. Price Industries.
 - f. Titus.
 - 2. Basis of design: Price LBPH
 - 3. The grilles shall have fixed 0 degree deflection blades spaced 7/16 inch on center. The blades shall run parallel to the long dimension of the grille.
 - 4. The grille blades, border, and mullions material shall be heavy extruded aluminum construction.
 - 5. Units wider than 24 inches shall be supplied in multiple sections with mounting channels.
 - 6. The core shall be supplied 3/16 inch bars.
 - 7. Material – Extruded Aluminum.
 - 8. Material - Pattern Controller and Tees: Aluminum.
 - 9. Finish - Factory anodized by the manufacturer in the color specified in the plans.

10. Finish - Pattern Controller: Baked enamel, black.
11. Slot Width: As Scheduled
12. Number of Slots: As scheduled.
13. Length: As scheduled

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as 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.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 – LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Louvers.

1.3 WORK INCLUDED

- A. Provide labor, materials, equipment and services for the complete installation.

1.4 ACTION SUBMITTAL

- A. Product Data: For each type of product, including plans, elevations, dimensions, finishes, pressure drops, blade types, and arrangements.
- B. Provide original color charts for selection of finish.
- C. 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 details and dimensions of custom-fabricated louvers.
 - 4. Indicate location and size of each field connection.

1.5 COORDINATION

- A. Coordinate sizes and locations of openings, lintels and supports.

1.6 QUALITY ASSURANCE

- A. Performance data for water penetration and air resistance shall be tested in accordance with AMCA Publication 511 and shall comply with the requirements of the AMCA Certified Ratings Program.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. American Warming & Ventilating.
 - 2. Construction Specialties.
 - 3. Greenheck.
 - 4. Louvers & Dampers, Inc.
 - 5. Nailor.
 - 6. Ruskin.

2.2 LOUVERS

- A. Factory constructed aluminum louvers.
- B. Provide mullions where blade lengths exceed 60 in.
- C. With ½-in. x ½-in. mesh, 14 gauge wire, aluminum birdscreen secured in removable frame, secured to back of louver.
- D. Extruded sections of 6063-T5 alloy, 0.081 in. minimum thickness, 4 in. deep, unless otherwise called for.
- E. Sill extension and sill style as required by job conditions.
- F. 70% Kynar PVDF/1005 Fluoropolymer VEFE finish color. Color as selected at review submittal.
- G. Size, type and free areas indicated in location as called for on the Contract Documents.
- H. “Storm-proof” design with special curb to trap rain. Incorporates a drainable head member and stationary horizontal blades to channel water to the jambs, to vertical downspouts to escape at the sill.
- I. One-piece structural head, sill and jambs.
- J. All stainless-steel fasteners.
- K. Louvers based on Greenheck Model ESD-435.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field measure existing openings for custom louvers. Louver shall fill entire opening without the use of blank-off panels.
- B. Install equipment as per manufacturer's recommendations.
- C. Louver size called for is approximate wall/or masonry opening size. Adjust slightly to suit construction or coursing. Review architectural drawings or field conditions for rough opening size.
- D. Slope ductwork and plenum to louver weep hole or provide drain.

END OF SECTION 233723

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Listed double-wall gas vents.
- B. See Section 235113 "Draft Control Devices" for induced-draft and mechanical fans and for motorized and barometric dampers.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Listed Special Gas Vents.
- B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Heat-Fab, Inc.
 - 2. Metal-Fab, Inc.
 - 3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F (248 deg C) 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 (13-mm) airspace.
- D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.
- E. Outer Jacket: 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.

1. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
2. Sidewall Termination: Mitered termination with screen as permitted by appliance manufacturer.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Listed Special Gas Vents: Condensing gas appliances.

3.2 INSTALLATION OF LISTED VENTS AND CHIMNEYS

- A. Locate to 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 and grease exhaust ducts 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. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- E. Lap joints in direction of flow.
- F. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- G. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- H. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235216.13 – GAS-FIRED 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. This Section includes packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim, and accessories for heating hot water.

1.3 SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Source quality-control test reports: Indicate and interpret test results for compliance with performance requirements before shipping.
- D. Field quality-control test reports: Indicate and interpret test results for compliance with performance requirements.
- E. Warranty: Standard warranty specified in this Section.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. AHRI Compliance: Boilers shall be AHRI listed and must meet the minimum efficiency specified under AHRI BTS-2000 as defined by Department of Energy in 10 CFR Part 431.
- E. ANSI Compliance: Boilers shall be compliant with ANSI Z21.13 test standards for US and Canada.
- F. CSA Compliant: Boilers shall be compliant with CSA certification.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY

- A. Standard Warranty: Boilers shall include 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 Fire-Tube Condensing Boilers:
 - a. Heat Exchanger, Pressure Vessel and Condensation Collection Basin shall carry a 10 year limited warranty against defects in materials or workmanship and failure due to thermal shock.
 - b. All other components shall carry a one year warranty from date of boiler start up.

PART 2 - PRODUCTS

2.1 CONSTRUCTION

- A. Description: Boiler shall be natural gas fired, fully condensing, and fire tube design. The boiler shall be factory-fabricated, factory-assembled, and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.
- B. Heat Exchanger: The heater exchanger shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of a fully welded 316L stainless steel and of fire tube design. Fire tube shall be of the Wave Fire Tube design and capable of transferring 30,000 to 40,000 Btu's per tube. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. There shall be no

banding material, bolts, gaskets or “O” rings in the heat exchanger design. Cast iron, aluminum, or condensing copper tube boilers will not be accepted.

- C. The BOILER shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard. The BOILER shall operate at a minimum of 95% AFUE Efficiency (KHB/WHB055-285) and 94.4% THERMAL Efficiency (WHB399) as registered with AHRI. The BOILER shall be certified for indoor installation.
- D. The BOILER shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided for observing the burner flame and combustion chamber. The burner shall be a premix design constructed of high temperature stainless steel with a woven Fecralloy outer covering to provide smooth operation at all modulating firing rates. The BOILER shall be supplied with a negative pressure regulation gas valve and be equipped with a pulse width modulation blower system to precisely control the fuel/air mixture to the burner. The BOILER shall operate in a safe condition with gas supply pressures as low as 4 inches of water column. The burner flame shall be ignited by direct spark ignition with flame monitoring via a flame sensor.
- E. The BOILER shall utilize a 24 VAC control circuit and components. The control system shall have a factory installed display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The BOILER shall be equipped with a temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 30 psi (standard); outlet water temperature sensor with a dual thermistor to verify accuracy; system supply water temperature sensor; outdoor air sensor, flue temperature sensor with dual thermistor to verify accuracy; low water cut off with manual reset, blocked drain switch and a condensate trap for the heat exchanger condensate drain.

2.2 TRIM

- A. Safety Relief Valve:
 - 1. Size and Capacity: 30 lb.
 - 2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
- B. Pressure Gage: Minimum 3-1/2 inch diameter. Gage shall have normal operating pressure about 50 percent of full range.
- C. Drain Valves: Minimum NPS 3/4 or nozzle size with hose-end connection.
- D. Condensate Neutralization Kit: Factory supplied condensate trap with condensate trip sensor, high capacity condensate receiver prefilled with appropriate medium.

2.3 CONTROLS

- A. The BOILER shall feature the “SMART SYSTEM™” control which is standard and factory installed with 128 x 128 resolution display, password security, outdoor air reset, pump delay with freeze protection, pump exercise, ramp delay featuring six steps, domestic hot water prioritization with limiting capabilities, USB drive for simple uploading of parameters and a PC port connection for connection to a local computer for programming and trending. A secondary operating control that is field mounted outside or inside the appliance is not acceptable. The BOILER shall have alarm contacts for any failure, runtime contacts and data logging of runtime at given modulation rates, ignition attempts and ignition failures. The BOILER shall have a built-in “Cascade” with leader redundancy to sequence and rotate while maintaining modulation of up to eight boilers of different Btu inputs without utilization of an external controller. The internal “Cascade” function shall be capable of lead-lag, efficiency optimization, front-end loading, and rotation of lead boiler every 24 hours. The BOILER shall be capable of remote communication via optional CON-X-US™ Remote Connectivity with the capability of historical trending and sending text message or email alerts to notify the caretaker of a boiler alarm and remote programming of onboard boiler control. The control must have optional capability to communicate via Modbus protocol with a minimum of 46 readable points. The BOILER shall have an optional gateway device which will allow integration with LON or BacNet protocols.
- B. The “SMART SYSTEM™” control shall increase fan speed to boost flame signal when a weak flame signal is detected during normal operation. A 0-10 VDC output signal shall control a variable speed boiler pump (pump shall be supplied by manufacturer) to keep a fixed Delta T across the boiler regardless of the modulation rate. The BOILER shall have the capability to receive a 0-10 VDC input signal from a variable speed system pump to anticipate changes in system heat load in order to prevent flow related issues such as erratic temperature cycling.
- C. The BOILER shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 46 connection points for safety and operating controls, i.e., Alarm Contacts, Runtime Contacts, Low Water Cut Off, Louver Proving Switch, Tank Thermostat, Domestic Hot Water Building Recirculation Pump Contacts, Domestic Hot Water Building Recirculation Temperature Sensor Contacts, Remote Enable/Disable, System Supply Temperature Sensor, Outdoor Temperature Sensor, Tank Temperature Sensor, Modbus Building Management System Signal and Cascade Control Circuit. A high voltage terminal strip shall be provided for Supply voltage. Supply voltage shall be 120 volt / 60 hertz / single phase on all models. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump, the Boiler pump and the Domestic Hot Water pump. Retain subparagraph and associated subparagraphs below if interface with building automation system is through hardwired points and minimal interface is required. If extensive interface is required, delete below and retain second subparagraph below.

2.4 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

- B. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

2.5 VENTING

- A. Exhaust flue shall be UL listed, Category IV approved stainless steel sealed vent material from one of the approved manufacturers listed in the Installation and Operation manual. Boilers exhaust vent length must be able to extend to 100 equivalent feet.
- B. Intake piping shall be of approved material as listed in the Installation and Operations manual. Boilers intake pipe length must be able to extend to 100 equivalent feet.
- C. Boiler venting and intake piping configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual.
- D. Boiler shall come standard with a flue sensor to monitor and display flue gas temperature on factory provided LCD display.
- E. Refer to manufacturer's Installation and Operations manual for detailed venting instructions and approved manufacturers.

2.6 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 ASME Boiler and Pressure Vessel Code.
- C. Allow Owner access to source quality-control testing of boilers. Notify Owner's Representative at least 14 days in advance of testing.

2.7 MANUFACTURERS

- A. Basis of Design: Lochinvar Knight – wall hung.
- B. Acceptable Makes:
 - 1. Lochinvar.
 - 2. Weil-McLain
 - 3. Laars

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
 - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in of 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. Install equipment on 4" concrete housekeeping pad.
- 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. Install boilers level on concrete bases.
- 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 gas piping to boiler gas-train inlet with union. Piping shall be at least full size of equipment connection. Provide a reducer if required.
- E. Connect hot-water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.
- F. Install piping from safety relief valves to nearest floor drain.
- G. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections.

H. Ground equipment according to Division 26.

I. Connect wiring according to Division 26.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions. Complete startup form included with Boiler and return to Manufacturer as described in the 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.
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.

C. **Occupancy Adjustments:** When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

D. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.
4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Architect in advance of test dates.
8. Perform a combustion analysis after installation and adjust gas valve per the Installation and Operations manual and note in startup report.
9. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

- A. Engage a factory representative or a factory-authorized service representative for boiler startup and to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION

SECTION 237200 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged fixed-plate energy recovery with integral reversible Heat Pump.

1.2 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.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: One set(s) of each type of filter specified.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. 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."

2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."

C. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.

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." The unit must pass commercial flammability requirements and shall not be labeled "For Residential Use Only".
2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

1.6 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 metal frames with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, wall and roof penetrations with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of 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 AIR-TO-AIR ENERGY RECOVERY HEAT PUMP AIR HANDLING UNITS

- A. General:

1. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
2. Unit shall be ASHRAE 90.1 compliant.

B. Description:

1. Outdoor mounted, factory assembled heat recovery and heat pump unit consisting of Heat recovery flat plate heat exchanger, compressor, tube and fin coils, EC variable speed plug fans, filters, refrigerant piping with accessories.
2. The heat recovery is utilized to optimize the heat pump operation
3. All electrical components are UL or CSA certified
4. Electrical components are mounted in the electrical compartment accessible for the panel door

C. Construction:

1. General: Air-to-Air Energy Recovery Ventilators shall be fully assembled at the factory and consist of a fixed-plate crossflow heat exchanger with integral heat pump for improved heat recovery performance. Cabinet shall be powder coated steel construction, with ½” closed cell insulation. Interior panels shall be all galvanized. filter assemblies for both intake and exhaust air, heat recovery core, supply air blower assembly, exhaust air blower assembly, heat pump arrangement, and electrical control box with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection. Entire unit, with the exception of field-installed components, shall be assembled and test operated at the factory.
2. Materials: Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
3. Access doors shall be hinged with airtight closed cell foam gaskets.
4. Cabinet Insulation: Unit walls and doors shall be insulated with 1/2 inch, closed cell foam.
5. Heat Recovery Heat Exchanger: Heat exchanger shall be plated aluminum air-to-air heat recovery flat plate heat exchanger, with aluminum frame.
6. Filter Section: Filters for Exhaust and Supply shall be provided. Sealed access doors shall be provided. Filter section shall have adjustable holders to fit filters between 1” up to 5” thick. Filters shall be rated for MERV 13.
7. Control Center/Connections: The unit shall have a line-cord power connection and be supplied with an internal 24 VAC transformer and relay
8. Blower Section:
 - a. Blower assemblies shall consist of a EC variable speed direct-driven backwards curved blower.
 - b. Blower assemblies shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
 - c. Blower section to have a sealed cowling from the coil to the inlet of the blower. Blower inlet shall have inlet ring for smooth transition and efficient operation.
9. Drain Pan: Stainless steel drain pans shall be fitted under each of the tube and fin coils, with drain tube connection extending out the side of the unit.

D. Motors:

1. Blower motors shall be direct drive EC variable speed backwards curved plug blowers, with manually adjustable 0-10VDC controller for field balancing. Separate blowers shall be provided for Supply Air and Exhaust Air.
- E. Heat Pump:
1. Compressor: Unit shall be provided with two-stage capacity control scroll compressor, hermetically sealed, internal oil pump and discharge check valve
 2. Heat Pump Coils: Frame mounted coils, with distributor and capillary tubes shall be provided for “internal” and “external” heat exchangers, and reversible for heat pump application.
 3. Refrigerant Circuit Components: Provide required refrigeration components such as reversing valve c/w solenoid, Suction accumulator, Bi-directional TX valve, Bi-directional filter drier, sight glass, charge compensator, high and low pressure switches
- F. Unit Controls provided by Micro-Processor based PIC Controller with the following features:
1. Digital display of temperature reading and set-point
 2. 24 volt single phase control
 3. Contactors and fuses as required
 4. BACnet communication protocol ready (requires optional BACnet card)
 5. RTD/Thermocouple/temperature sensor input
 6. Staging of compressor unloading to match load
 7. Anti short cycle protection for compressor
 8. Low voltage indicator alarm
 9. Controller hard wired to safety/relay protection devices
 10. Connection point for remote on/off switch
 11. Connection point for general alarm
 12. Manual/Auto switch for blower operation
 13. Status indicators shall be provided for :
 - a. Refrigerant High Pressure
 - b. Refrigerant Low Pressure
 - c. Compressor Fault
- G. Accessories:
1. Electric Defrost Heater, with electrical contactors and integral safeties, mounted at the supply inlet connection
 2. BACnet communications card
 3. Remote change over panel.
 4. 24” high insulated wind rated curb
- H. Manufacturers:
1. Basis of Design: Transom Corporation.
 2. Approved equivalent - Greenheck, Aaon, RenewAire

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 so supply and exhaust airstreams flow in opposite directions and rotation is away from exhaust side to purge section to supply side.
 - 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
 - 2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
 - 3. Make final ductwork connections (outdoor air intake, ventilation air outlet, return air intake, exhaust air outlet) with flexible duct connector.
 - 4. Install isolation dampers on outdoor air and exhaust air ductwork as close to louvers as possible. Route wiring from damper actuators back to unit controller. Make final terminations.
 - 5. Mount programmable timeclock, where indicated, and route wiring from timeclock back to unit controller. Make final terminations.
 - 6. Access doors and panels are specified in Section 233100 "Air Duct Accessories."
 - 7. Install proper condensate drain piping to nearest drain
- B. Equipment Mounting:
 - 1. Install indoor air-to-air energy recovery equipment on field fabricated frames. Frames shall be designed to handle seismic loads.
 - 2. Install outdoor air-to-air energy recovery equipment on insulated roof curbs, 24" minimum in height.
- C. Install units with clearances for service and maintenance.
- D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 CONNECTIONS

- A. Install piping adjacent to unit to allow service and maintenance.
- B. Connect piping to units mounted on vibration isolators with flexible connectors.
- C. Comply with requirements for ductwork specified in Section 233113 "Metal Ducts."
- D. Install electrical devices furnished with units but not factory mounted.
- E. Mount and wire programmable timeclocks. Provide low voltage control wiring from timeclock to associated unit. All wiring and accessories shall comply with requirements of Specification Sections within Division 26.

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 initial temperature and humidity set points.
 - 5. 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.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

3.6 SPARE PARTS

- A. Turn over one (1) full set of filters to the Owner upon substantial completion.

3.7 SEQUENCE OF OPERATION

A. Unoccupied Mode:

- 1. During unoccupied hours, the outdoor air and exhaust air dampers shall be fully closed and the supply air and exhaust air fans shall be de-energized. The dampers shall not close until the respective fan is fully off.

B. Occupied Mode:

1. Fan Control:

- a. During occupied hours the supply fan and exhaust fan shall run continuously. The fans shall not start until their respective damper is fully open.

2. Damper Control:

- a. During normal operation, the outdoor air and exhaust air dampers shall be fully open. The bypass damper shall be fully closed.
- b. During economizer operation, the outdoor air and exhaust air dampers shall be fully open, and the bypass damper shall be fully open. The unit shall be in economizer mode when the outdoor air temperature is between 62 and 72°F.

END OF SECTION 237200

SECTION 238129 – VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes variable capacity refrigerant HVAC units consisting of separate evaporator-fan and compressor-condenser components.

1.3 SYSTEM DESCRIPTION

- A. The variable capacity, heat pump/heat recovery air conditioning system shall be a SAMSUNG Electronics DVM S (Variable Refrigerant Flow) System. The DVM S systems shall be HR (simultaneous cooling and heating) split system heat recovery or HP (cool/heat) split system heat pump with multiple indoor units.
- B. PIPING
- C. Piping to multiple indoor units requires additional piping components. The VRF equipment manufacturer's Y-joint fittings and/or Heat Recovery Mode Control Units (MCU) must be used to branch the main refrigerant lines.
- D. The VRF equipment manufacturer's Tee fittings must be used to connect outdoor units when multiple module systems are being installed (systems with more than one outdoor unit).

1.4 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- D. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit. Additional refrigerant is required based on diameters and lengths of system liquid refrigerant lines and indoor equipment model and quantity.
- E. The installing contractor must have attended Samsung DVM S installation training prior to in-

stalling the system.

- F. Service and installation manuals must be readily available on the manufacturer's website without entering a username and password.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. 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."
- I. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.5 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.
 - 3. Refrigerant piping diagrams including sizes and lengths of piping.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For variable refrigerant HVAC units to include in emergency, operation, and maintenance manuals.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 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: Ten years from date of Substantial Completion.
 - b. For Parts: Ten years from date of Substantial Completion.
 - c. For Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
 - 1. Samsung – Basis of Design
 - 2. LG HVAC
 - 3. Mitsubishi

2.2 HEAT RECOVERY CONDENSING UNIT (208/230V, 3Ø)

A. General:

The heat recovery outdoor unit shall be used specifically with SAMSUNG DVM S2 Heat Recovery components. The heat recovery outdoor unit shall consist of the AM***BXVGFR/AA outdoor unit, MCU (Mode Control Unit, MCU-S*NE**N), indoor units (AM****N****/AA models), and SAMSUNG DVM S NASA Control Network Solution (Control systems). The outdoor units shall be equipped with multiple circuit boards that interface to the SAMSUNG DVM S NASA Control Network Solution (Control systems) and shall perform all functions necessary for operation. The outdoor unit shall have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

- 1. The heat recovery system shall have the ability of simultaneous heating and cooling operation modes on all indoor units.
- 2. The Heat Recovery condensing unit salt spray test method: ASTM B117-18 - the heat ex-

- changer showed no unusual rust or corrosion development to 3,000 hours.
3. The heat recovery system shall have the ability to change operation mode (MAIN heating / MAIN cooling) without turning off the compressors allowing for constant heating and cooling operation.
 4. The heat recovery system shall have rotational defrost capability (modular systems only) to perform defrost operations while still providing heat to indoor units (operation and conditions restrictions exist).
 5. The outdoor unit shall have advanced oil recovery cycle logic operation that shall not interrupt heating or cooling operation. The oil recovery cycle duration shall not exceed three (3) minutes while in cooling mode or six (6) minutes while in heating mode. While in heat mode, any defrost cycle lasting over three (3) minutes shall be considered an oil recovery cycle.
 6. Advanced intelligent defrost logic to significantly reduce defrost cycle frequency by monitoring air resistance across the condenser coil during heating operation to determine defrost operation initiation to prevent unnecessary defrost cycles.
 7. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor nominal capacity as standard. Connection up to 184% is possible under certain design conditions (refer to details in engineering manuals provided by the manufacturer).
 8. The heat recovery system shall have installer enabled snow blowing settings to prevent snow accumulation on top of unit.
 9. The heat recovery system shall have optional night quite modes to reduce unit sound in evenings reducing fan and/or compressor sound (4 level settings).
 10. The heat recovery system shall have current control to limit current (50% - 100% of design current) adjustable at outdoor unit or web accessible, central control devices provided by the VRF manufacturer.
 11. The heat recovery system compressors shall be SAMSUNG, hermetically sealed, inverter driven, flash injected, asymmetric, DC scroll type. No fixed capacity compressors will be present in the refrigerant system.
 12. Outdoor unit (individual modules) shall have a sound rating no higher than 67 dB (A).
 13. All three refrigerant lines from the outdoor unit to the MCU (heat recovery Mode Control Unit) and Y-joints shall be insulated.
 14. The heat recovery system shall allow adjustment of target evaporator coil temperatures in cooling mode and target heating discharge pressures depending on project conditions for heating and cooling calibration thus saving energy.
 15. The heat recovery outdoor unit shall have an accumulator with ARV (accumulator return

- valve) control.
16. The heat recovery outdoor unit shall have a high pressure safety switch, high voltage fuses, over-current protection, phase detection protection, thermal fan protection, low pressure protection, compressor overcurrent protection, fan motor voltage protection, current transformer(s), crank case heating, and intelligent logic to ensure proper operation within unit design limitations and operational parameters.
 17. The inverter compressor PCB(s) shall be cooled with liquid refrigerant circuit(s) and air-cooling fins to operate at optimal temperatures and to prevent failure due to overheating.
 18. The heat recovery outdoor unit shall have the ability to operate with a maximum height difference of 361 feet between the outdoor unit and the lowest indoor unit when the condensing unit is installed higher than the indoor units (with modified piping and PDM kit when greater than 164 feet). The heat pump outdoor unit shall have the ability to operate with a maximum height difference of 361 feet between the outdoor unit and the highest indoor unit when the condensing unit is installed lower than the indoor units (conditions apply when over 131). Maximum 3,280 feet total refrigerant tubing length. The greatest length is not to exceed 656 (722 equivalent) feet between outdoor unit and the farthest indoor unit.
 19. Indoor units on Heat Recovery systems shall have a maximum vertical separation of 131 feet between the highest and lowest indoor units (maximum 49 feet if connected to the same Mode Control Unit).
 20. When using supported MCU (Mode Control Unit) models, indoor units that will be used for cooling only year-round may be piped direct to the liquid and suction pipes bypassing MCU connection.
 21. The heat recovery outdoor unit shall be capable of operating in heat mode between -22°F ~ 75°F (-30°C ~ 24°C) ambient temperatures.
 22. The heat recovery outdoor unit shall be capable of operating in cool mode between 23°F to 120°F (-5°C to 49°C) ambient temperatures as standard. Cool mode operation between 5°F ~ 122°F (-15°C ~ 50°C) is possible with a modified pipe design.
 23. The heat recovery outdoor unit shall be capable of operating in cool mode down to -13°F (-25°C) ambient temperatures with use of low ambient cooling hood and side/rear guard accessories (LACH) to provide 100% cooling capacity.
 24. The heat recovery outdoor unit shall have high efficiency, individual oil separator(s) for each compressor plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
 25. The heat recovery outdoor unit shall have a flat-plate type subcooler to subcool liquid refrigerant further to increase capacity and performance with long pipe lengths and to decrease refrigerant sounds at indoor equipment.

26. The heat recovery outdoor unit shall have a removable EEPROM at the main PCB to store all unit data. All data on the outdoor unit EEPROM shall be viewable from the manufacturer provided service software. The outdoor unit main EEPROM shall be removable allowing replacement of outdoor unit PCB without losing digital, field programmed data. The outdoor unit removable EEPROM shall store the following unit data: unit model number, unit serial number, unit main PCB firmware and MICOM version, sub-PCB firmware and MICOM version, fan PCB firmware and MICOM version, inverter PCB 1 and inverter PCB 2 firmware and MICOM version, auto-trial commissioning startup data, the last 30 minutes of operation data, and field programmed unit name/tag viewable on controls and service software.
27. The heat recovery outdoor unit shall have the ability to discharge inverter PCB capacitor voltage using service buttons on the outdoor unit main PCB. The capacitor stored-voltage discharge feature shall allow safe inverter PCB replacement.
28. The heat recovery outdoor unit shall have outdoor unit pump-down operation capability allowing storage of refrigerant while opening sealed refrigerant pipe system outside of outdoor unit chassis while performing service. The outdoor unit refrigerant storage shall be greater than the supplied factory R-410A charge.
29. The heat recovery outdoor unit shall have individual outdoor module pump-out operation capability allowing the majority of refrigerant in an outdoor unit to be pumped out. The pump-out feature shall allow service of sealed refrigerant system within an outdoor unit chassis.
30. The heat recovery outdoor unit shall allow temporary disabling of individual compressors to allow system operation at reduced capacity after a compressor or compressor component related issue (when more than one compressor is present in system). Disabling of a compressor shall temporarily remove error codes and allow system operation.
31. The heat recovery outdoor unit shall have capability to reduce compressor Hz (heating capacity) further when average indoor unit ((set temperature – room temperature) < 3.6° F) while operating in heating mode, thus saving energy.
32. The heat recovery outdoor unit shall have capability to reduce compressor Hz (cooling capacity) when average indoor unit ((room temperature – set temperature) < 3.6° F) while operating in cooling mode, thus saving energy.
33. The heat recovery outdoor unit compressors shall have a soft-start function to reduce electricity demand during system start and to increase compressor reliability.
34. In the event of system error due to outdoor unit failure, the heat recovery outdoor unit shall display codes that specify a precise error and which outdoor unit PCB is the cause.

B. Unit Cabinet:

1. The chassis shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:

1. All fan motors shall be variable speed BLDC type.
2. All fan motors shall have inherent protection, thermal protection, and have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The heat recovery outdoor unit shall have vertical discharge airflow.
6. The heat recovery outdoor units shall not require any field installed components or component modification to allow ducting of discharge air. Outdoor unit capacities 6 – 14 tons (nominal) shall have the capability for ducting of discharge air up to 0.43" WC static pressure with factory provided dimensional design drawings. Outdoor unit capacities 16 – 20 tons (nominal) shall have the capability for ducting of discharge air up to 0.32" WC static pressure with factory provided dimensional design drawings.

D. Refrigerant

1. R410A refrigerant shall be required for the heat recovery outdoor systems.
2. Additional refrigerant is required. Amount is based on installed liquid refrigerant pipe diameters and lengths and indoor equipment model number and quantity.
3. Modular systems shall require outdoor refrigerant kits for module connection provided by the manufacturer.

E. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The Heat Recovery condensing unit salt spray test method: ASTM B117-18 - the heat exchanger showed no unusual rust or corrosion development to 2,280 hours.
3. The coil shall be protected with an integral metal guard.
4. The heat exchanger shall consist of two separate circuits to enhance the heat pump defrost cycle. The unit shall use the entire coil initially for the defrost cycle. To resume heating faster in extreme conditions, the upper section shall return to heating operation while the lower section continues to defrost.

F. Compressor:

1. The compressors shall have flash injection capability to increase performance in heating mode

- only. This will be automatically enabled by the outdoor unit(s) by forcing saturated refrigerant as a liquid flash mix directly into the scroll compression cycle increasing mass flow and overall system capacity. Compressors without flash injection shall not be present in the VRF heat recovery system.
2. All compressors shall be modulation capable, flash injected, DC inverter, scroll type.
 3. Refrigerant flow from the outdoor unit shall be controlled by means of capacity modulation capable, vapor injected, DC inverter, scroll compressor.
 4. Crankcase heaters shall be factory mounted on the compressors. For units without crankcase heaters, the compressors shall be warmed by the compressor inverter control PCB and motor windings.
 5. The outdoor unit compressor shall have variable modulation technology to modulate capacity. System capacity shall be completely variable down to 7,513 Btu/h.
 6. The outdoor unit compressor(s) shall have flash injection technology which can increase the mass flow rate of refrigerant and offset refrigerant condensing temperatures resulting in a capacity and performance improvement in heating mode. Compressors without flash injection shall not be present in the VRF heat recovery system.
 7. The compressor(s) will be equipped with an internal thermal overload.
 8. The compressor(s) shall be mounted to avoid the transmission of vibration.

G. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 3 phase, 60 hertz.
2. The 208/230 VAC outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, MCU (Mode Control Unit) and the outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, two-core, 16 AWG, shielded cable to provide total integration of the system (F1/F2).

2.3 MCU (MODE CONTROL UNIT) FOR HEAT RECOVERY SYSTEMS

A. General:

The MCU (Mode Control Unit) shall be specifically used with R410A, AM****X***R/AA and AM****X***R2AA heat recovery outdoor units. These units shall be equipped with a circuit board that interfaces to the SAMSUNG DVM S NASA Control Network Solution (Control systems) and shall perform all functions necessary for operation. The unit shall have a galvanized

steel finish. The MCU (Mode Control Unit) shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. The unit shall be mounted indoors. The sum of connected capacity of indoor units shall range from 7,000 – 216,000 btu/h capacity at one MCU depending on model. The AM****X***R/AA and AM****X***R2AA heat recovery outdoor units shall connect multiple MCUs, up to 16 total per system.

There shall be nine models of Mode Control Units: MCU-S4NEE1N, MCU-S6NEE1N, MCU-S4NEE2N, MCU-S2NEK1N, MCU-S1NEK1N, MCU-S2NEK2N, MCU-S4NEK3N, MCU-S6NEK2N, and MCU-S6NEK3N. The below table identifies MCU models and indoor unit connection data.

<u>MCU Model Number</u>	<u>Connectable Indoor Unit Qty.</u>	<u>Port Qty.</u>	<u>Sum of Indoor Unit Capacity (maximum)</u>
MCU-S1NEK1N	1 - 8	1	Up to 54,000 Btu/h
MCU-S2NEK2N	1 - 16	2	Up to 108,000 Btu/h
MCU-S4NEK3N	1 - 32	4	Up to 216,000 Btu/h
MCU-S6NEK2N	1 - 32	6	Up to 216,000 Btu/h
MCU-S6NEK3N	1 - 18	6	Up to 76,000 Btu/h

1. MCU-S1NEK1N shall have 1 port with a maximum connected quantity of 8 indoor units. The sum of indoor unit's capacity shall not exceed 54 MBH (54,000 btu/h). The MCU-S1NEK1N shall not connect under-ceiling indoor units without the installation of single zone EEV kits (MEV-A**SA).

2. MCU-S2NEK2N shall have 2 ports with a maximum connected quantity of 16 indoor units (maximum 8 indoor units per port). The sum of indoor unit's capacity shall not exceed 54MBH (54,000 btu/h) per port, and 108 MBH (108,000 btu/h) total. Two (2) adjacent ports shall be twinned using Y-Joint part number MXJ-YA1509M (purchased separately) when connecting indoor unit(s) greater than 54 MBH (54,000 btu/h), but less than 108 MBH (108,000 btu/h). The MCU-S2NEK2N shall not connect under-ceiling indoor units without the installation of single zone EEV kits (MEV-A**SA). Ports shall be twinned using Y-Joint part number MXJ-YA1509M (purchased separately) when connecting indoor units greater than 54 MBH (54,000 btu/h), but less than 108 MBH (108,000 btu/h). MCU-S2NEK2N shall allow series connection of additional MCU's reducing Y-joint installation to a maximum capacity of (108 MBH) 108,000 btu/h.

3. MCU-S4NEK3N shall have 4 ports with a maximum connected quantity of 32 indoor units (maximum 8 indoor units per port). The sum of indoor unit's capacity shall not exceed 54MBH (54,000 btu/h) per port, and 216 MBH (216,000 btu/h) total. Two (2) adjacent ports shall be twinned using Y-Joint part number MXJ-YA1509M (purchased separately) when connecting indoor unit(s) greater than 54 MBH (54,000 btu/h), but less than 108 MBH (108,000 btu/h). The MCU-S4NEK3N shall not connect under-ceiling indoor units without the installation of single zone EEV kits (MEV-A**SA). MCU-S4NEK3N shall allow series connection of additional MCU's reducing Y-joint installation to a maximum capacity of (216

- MBH) 216,000 btu/h.
4. MCU-S6NEK2N shall have 6 ports with a maximum connected quantity of 32 indoor units (maximum 8 indoor units per port). The sum of indoor unit's capacity shall not exceed 54MBH (54,000 btu/h) per port, and 216 MBH (216,000 btu/h) total. Two (2) adjacent ports shall be twinned using Y-Joint part number MXJ-YA1509M (purchased separately) when connecting indoor unit(s) greater than 54 MBH (54,000 btu/h), but less than 108 MBH (108,000 btu/h). The MCU-S6NEK2N shall not connect under-ceiling indoor units without the installation of single zone EEV kits (MEV-A**SA). MCU-S6NEK2N shall allow series connection of additional MCU's reducing Y-joint installation to a maximum capacity of (216 MBH) 216,000 btu/h.
 5. MCU-S6NEK3N shall have 6 ports with a maximum connected quantity of 18 indoor units (maximum 3 indoor units per port). The sum of indoor unit's capacity shall not exceed 19 MBH (19,000 btu/h) per port, and 76 MBH (76,000 btu/h) total. Two (2) adjacent ports shall be twinned using Y-Joint part number MXJ-YM1206M (purchased separately) when connecting indoor unit(s) greater than 19 MBH (19,000 btu/h), but less than 48 MBH (48,000 btu/h). The MCU-S6NEK3N shall not connect under-ceiling indoor units without the installation of single zone EEV kits (MEV-A**SA). MCU-S6NEK3N shall allow series connection of additional MCU's reducing Y-joint installation to a maximum capacity of (76 MBH) 76,000 btu/h.

B. MCU (Mode Control Unit) Cabinet:

1. The chassis shall be fabricated of galvanized steel.
2. Each cabinet shall house multiple refrigeration control solenoid valves and electronic expansion valves.
3. MCU-S1NEK1N shall house one tube-in-tube subcooling device with electronic expansion valve and temperature sensors to maintain design refrigerant temperatures (sub cooling). All pipe connections shall be braze type.
4. MCU-S2NEK2N shall house two tube-in-tube subcooling devices with electronic expansion valve and temperature sensors to maintain design refrigerant temperatures (sub cooling). All pipe connections shall be braze type.
5. MCU-S4NEK3N shall house four tube-in-tube subcooling devices with electronic expansion valve and temperature sensors to maintain design refrigerant temperatures (sub cooling). All pipe connections shall be braze type.
6. MCU-R4NEK0N shall house four tube-in-tube subcooling devices with electronic expansion valve and temperature sensors to maintain design refrigerant temperatures (sub cooling). All

pipe connections shall be braze type

7. MCU-S6NEK3N shall house six tube-in-tube subcooling devices with electronic expansion valve and temperature sensors to maintain design refrigerant temperatures (sub cooling). All pipe connections shall be braze type.

C. Refrigerant:

1. R410A refrigerant shall be required for MCU's (Mode Control Units).

D. Refrigerant valves:

1. The unit shall be furnished with multiple two position solenoid valves.
2. When connecting an indoor unit greater than 54,000 btu/h to MCU-S2NEK2N, MCU-S4NEK3N, and MCU-S6NEK2N, two adjacent branch circuits shall be joined together at the branch controller to deliver an appropriate amount of refrigerant. The two refrigerant valves shall operate simultaneously. The Y-joints necessary to connect 2 circuits or ports are sold separately.
3. When connecting an indoor unit greater than 19,000 btu/h but less than or equal to 48,000 btu/h to MCU-6NEK3N, two adjacent branch circuits shall be joined together at the branch controller to deliver an appropriate amount of refrigerant. The two refrigerant valves shall operate simultaneously. The Y-joints necessary to connect 2 circuits or ports are sold separately.
4. When connecting an indoor unit greater than 19,000 btu/h and less than or equal to 48,000 btu/h to MCU-R4NEK0N (HR Changer) or MCU-S4NEK3N, two adjacent branch circuits shall be joined together at the branch controller to deliver an appropriate amount of refrigerant. The two refrigerant valves shall operate simultaneously. The Y-joints necessary to connect 2 circuits or ports are sold separately.
5. Electronic expansion valves and solenoid valves shall be used to control the variable refrigerant flow inside each MCU (Mode Control Units).

E. Integral Drain Pan:

1. MCU-S1NEK1N, MCU-S2NEK2N, MCU-S4NEK3N, MCU-S6NEK2N, MCU-S6NEK3N, and MCU-6NEK3N shall include an integral condensate pan. Drain connection is not required

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, and 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
3. The MCU (Mode Control Unit) shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, MCU (Mode Control Unit) and the heat pump/heat recovery outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, two conductor, 16 AWG, shielded cable to provide total integration of the system.

2.4 WIND/HAIL GUARD ACCESSORY FOR 3Ø UNITS (WHG-**))

A. General

1. Wind/hail guards shall be provided on the outdoor units.
2. Wind/Hail Guards are available for the top (hood), right, left, rear, and front sides of the outdoor unit.
3. Refer to manufacturer documentation for compatible wind/hail guard accessory model numbers and compatibility.

2.5 BASE PAN HEATER FOR 3Ø AIR-COOLED CONDENSING UNITS

A. General

1. The Base Pan Heater Kit shall be compatible with Heat Pump and Heat Recovery models.
2. Base pan heater used to prevent ice formation in the bottom of the outdoor units and to promote water drainage after defrost cycles in extreme low ambient temperatures.
3. Application of base pan heaters is recommended when:
 - (a) The outdoor unit will operate in low temperature, high humidity conditions for periods 72 hours or longer.
 - (b) When outside temperatures will drop below freezing for 24 hours.
4. The base pan heater shall activate when:
 - (a) Outdoor temperature is below 30°F (-1°C)
 - (b) The outdoor unit is in heating mode

- (c) When an outdoor unit has been idle for 30 minutes and outside temperature is 41°F (5°C) or lower the base pan heater will turn on every 30 minutes and for 5 minutes and the fan will operate for 1 minute (if snow accumulation prevention is enabled).

B. Required components

1. Each outdoor unit will require a base pan heater and a control box.
2. Refer to manufacturer documentation for compatible wind/hail guard accessory model numbers and compatibility.

2.6 WINDFREE™ HIGH WALL INDOOR UNIT (AM0TNVDCH/AA)**

A. General:

The wall-mounted indoor unit section shall have a slim silhouette. The wall-mounted indoor unit shall be compatible with DVM S HR (Heat Recovery) outdoor units and MCU (Mode Control Unit, MCU-S*NE**N) or DVM S HP (Heat Pump) outdoor units. The wall-mounted indoor unit shall support individual control using SAMSUNG DVM S NASA Control Network Solution (Control systems

Indoor Unit:

1. The indoor unit shall feature WindFree™ operation. WindFree™ mode will close the air outlet louver and disperse air into the space through thousands of micro-holes on the front of chassis and the air outlet louver keeping the space cool without cold drafts. The WindFree™ unit delivers an air current that is under 0.15 m/s while in WindFree™ mode. Air velocity that is below 0.15 m/s is considered “still air” as defined by ASHRAE 55-2013 (American Society of Heating, Refrigerating, and Air-Conditioning Engineers).
2. WindFree™ mode only operates in Cooling and Dry modes.
3. The indoor unit shall automatically enter WindFree™ mode, as the room temperature approaches set temperature, when 2-Step cooling function is set.
4. The indoor unit can be manually put into “WindFree™” mode with an optional wired controller, wireless controller, or central control.
5. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board and fan motor.

B. Unit Cabinet:

1. The casing shall have a gloss white finish, HIPS chassis certified to UL94 V0.
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and four (4) directions for draining shall be standard.

3. Drain hose shall be on the right-hand side of the drain pan (when facing the front) as standard with optional left-hand side connection.
4. There shall be a separate galvanized steel mounting plate which secures the unit firmly to the wall.
5. The indoor unit shall have easy-access pipe and drain connections via access panel on front of unit for easier installation and service allowing maintenance without pulling the unit out from the wall thus preventing property damage.
6. Two digit, 7-segment display on the front of the unit, shall provide unit operation, temperature, and error status.

C. Fan:

1. The indoor fan assembly shall be a cross-flow fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. Motorized air sweep louvers shall provide automatic change in airflow by directing the air up and down and left to right to provide uniform air distribution.
4. The indoor fan shall consist of three (3) speeds, High, Mid, and Low. Auto fan speed setting is available.

D. Filter:

1. Return air shall be filtered by means of an electro-static, pleated, easily removable, washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with slit fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The coil fins are coated with hydrophilic paints.
7. Both refrigerant lines to the wall-mounted indoor unit shall be insulated.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
3. The control circuit between the indoor units, MCU (Mode Control Unit) and the heat pump/heat recovery outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, two-core, 16 AWG, shielded cable to provide total integration of the system.
4. The indoor unit shall have a thermal fuse under the high-voltage terminal block to disable unit in the event of overheating due to electrical malfunction/poor connection.

G. Controls:

1. This unit shall use controls provided by the VRF manufacturer to perform functions necessary to operate the system. Please refer to the “Controls” section of this guide specification for details on controllers and other control options.
2. The indoor unit shall have An EEPROM on its PCB to store all unit data. All data on the indoor unit EEPROM shall be viewable from the manufacturer provided service software. The indoor unit EEPROM shall store the following unit data: unit model number, unit serial number, unit PCB firmware and MICOM version, and field programmed unit name/tag viewable on controls and service software.
3. The indoor unit shall have advanced external heater control programming capability for supplemental heat. External heat control shall be done with MIM-B14 external contact control module (refer to the “Controls” section of this guide specification). External heat control signal shall enable and disable a supplemental heat source based on selectable room temperature and set temperature differences. External heat control signal shall include a selectable time delay before the supplemental external heat source is activated.
4. The indoor unit shall have advanced unoccupied room control capability. Unoccupied room control can be used to reduce system demand when a room is not occupied by changing zone settings. Unoccupied room control shall be done with MIM-B14 external contact control module (refer to the “Controls” section of this guide specification). The unoccupied settings can be modified central control gateways provided by the VRF manufacturer or programmed with the manufacturer provided service software. Unoccupied room control shall provide four setting options to modify indoor unit operation when in “unoccupied mode”. Settings shall include indoor unit ON/OFF, fan speed, and set temperature adjustment.
5. The indoor unit shall feature a Dual Set point function that allows users to set separate heating and cooling set temperatures using MWR-WG00UN wired controller and central control options MIM-D01AUN, MIM-B17BUN, and MIM-B18BUN. Dual set temperature allows the user to specify a deadband where the unit will not heat or cool when room temperature is between the heating and cooling set temperatures. Dual set temperature can be used with heat pump or heat recovery systems.

6. The indoor unit shall feature an Emergency Temperature Output (ETO) function that will provide a signal when an indoor unit is in error status. When enabling ETO, a high room temperature threshold can also be programmed to provide a signal when the room temperature limit has been exceeded. The ETO signal can be used to activate backup systems, provide a simple signal to a building management system, or to provide a simple visual/audible notification locally (ex: LED, buzzer, etc.). An MIM-B14 External Contact Control interface module is required for each unit that will provide or receive an ETO signal.

2.7 CONTROLS OVERVIEW

A. General:

The DVM S Controls Network Solution shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

B. Electrical Characteristics:

1. General:

- (a) Local DVM S Controls Solution devices shall operate at 12V DC. Controller power and communications shall be via a common communications bus.
- (b) Central DVM S Controls Solution devices shall communicate via a common central layer communications bus.

C. Wiring:

1. Main system control wiring (COM1, F1/F2) shall be installed in a system daisy chain configuration from the indoor equipment to MAIN outdoor unit. This cable shall be 16 AWG X 2, shielded cable.
2. Zone control wiring (COM2, F3/F4) to wired remote controllers (MWR-*****N) shall be run from the indoor unit terminal block to the controller associated with that unit. This cable shall be 16 AWG X 2, shielded cable.
3. Control wiring for system controllers and centralized controllers (upper level) shall be installed in a daisy chain configuration from main condensing unit to main condensing unit (R1/R2), to system controllers.
4. Communication wire connection (OF1/OF2) between main outdoor unit modules (systems with 2 or more modules) must be connected from the MAIN unit to SUB1 and SUB2 (where applicable). This wire shall be 2-conductor, 16 AWG X 2, shielded cable.
5. MST-P3P (S-NET 3 software) shall be capable of being networked with up to 16: MIM-D00AN (DMS2), MIM-D01AUN (DMS2.5), MIM-B17N (BACnet gateway 2.0), MIM-

B17BUN (BACnet gateway 2.5), MIM-B18 (LonWorks gateway2.0), and/or MIM-B18BUN (Lon Works gateway 2.5) system controllers for web/LAN based control for consolidated control.

D. Wiring type:

1. COM1 and COM2 control wiring shall be 2-conductor, 16 AWG X 2, shielded cable.
2. Network wiring shall be CAT-5e with RJ-45 connection.

2.8 DVM CONTROL NETWORK SOLUTION

A. General:

The SAMSUNG DVM S NASA Control Network Solution consists of remote controllers, system controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The SAMSUNG DVM S NASA Control Network Solution shall support operation monitoring, scheduling, error monitor, power distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces.

2.9 MULTI-FUNCTION CONTROLLER – ADVANCED WIRED CONTROLLER (MWR-WG00UN)

A. Compatibility:

1. DVM S systems (AM*****AA, MCM-D211UN), DVM Chiller FCU kits (MCM-F00N), 2020 RAC single zone high-wall units (AR**TSF*BWKNCV, RNS***BT), CAC indoor units (AC0***N***/AA) and FJM indoor units (AJ0**TN*DCH/AA, JNH***DT).

B. Connection:

1. The wired controller shall control up to 16 SAMSUNG indoor units (defined and controlled as one group).

C. Dimensions:

1. The wired controller shall be approximately 4 3/4" x 4 3/4" in size and white in color

D. The wired controller shall control SAMSUNG indoor units as follows:

1. Air handler operation ON/OFF
2. Air handler operation mode, set temperature, air flow direction, fan speed, individual louver control (with supported indoor units).
3. Discharge air temperature (with supported indoor units)

4. Dual Set Temperature (with supported indoor units)
 5. Setback function
 6. Quiet and sleep modes
 7. Error display (up to 10 error codes with descriptions)
 8. Filter replacement alarm display and reset
 9. Single indoor unit control or multiple unit control (maximum 16 units)
 10. Energy saving operation:
 - (a) Upper/lower temperature setting
 - (b) Automatic operation stop function
 - (c) Energy saving operation mode
 - (d) Energy consumption monitoring
 11. Weekly operating schedule setting:
 - (a) Weekly and yearly operating schedule
 - (b) Options to set: desired A/C operation mode, setting temperature, power mode (ON/OFF), and fan speed to operate based on weekly or daily schedules
 - (c) Optional schedule exception day setting
 12. Advanced HP auto changeover control and configuration
 13. Supports multiple languages
 14. Error code display with description (ten most recent error codes)
- E. Other wired controller features:
1. Different button permission levels
 2. Partial button lock option (on/off, temperature setting, fan speed, all modes, auto mode, cool mode, heat mode, dry mode, fan mode, and schedule setting buttons can be locked individually)
 3. Backlight with option to dim the display after a specified time
 4. Daylight savings clock advance option

5. Upper and lower temperature setting restriction
6. Heat mode skip (cooling only)
7. Restrict wireless controller signal (optional)
8. Real-time clock function - current time/day display function
9. Built in IR receiver for indoor unit control using a wireless controller and integral room temperature sensor.
10. Indoor unit operation state display
11. Indoor unit service mode support
12. Micro SD card slot for simple firmware updating
13. Individual louver/blade control for 4-way and mini 4-way cassettes.
14. Individual air direction control for 360 Cassette indoor units.
15. Quiet Mode setting (for supported units)
16. Service mode for connected indoor unit operation monitoring, addressing, and setup
17. Built-in room temperature sensor
18. Indoor unit operation state display
19. Service mode support (Indoor unit addressing, indoor unit cycle data monitoring, option code monitoring and setting, and option setting/monitoring).
20. Time synchronization with central control gateways provided by the VRF manufacturer.
21. WindFree™ display and control for supported indoor unit models.
22. Motion Detection Sensor Control (On/Off, Indirect/Direct) for supported indoor unit models. Indirect/Direct control only applies to supported units that have MCR-SMC and MCR-SMD installed.
23. Clean and Long reach function for supported indoor unit models.
24. Automatic air volume enable and status viewing (for Duct S models AM0**MNMDCH/AA, AM0**MNHDCH/AA, and AM0**RNMDCH/AA).
25. Maximum current control for DVM S 3Ø outdoor systems

F. Specifications:

1. Two (2) conductor connection, PLC, (F3/F4).
2. DC 12V (power supplied by indoor unit via F3/F4 connection).
3. RS485 communication (F3/F4).
4. Can sense temperature via internal sensor, temperature sensor inside the air handler, or use the average temperature between controller and air handler temperature sensors.
5. The wired controller shall have two screw terminals for wiring connections. Wire is not included with controller.
6. 16AWG X 2 shielded cable is necessary for proper operation.
7. The wired controller shall allow up to 328 feet of wire from the farthest connected indoor unit to the controller.

<i>Multi-Function Controller</i>			
<i>Item</i>	<i>Description</i>	<i>Operation</i>	<i>Display</i>
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Auto/Cool/Dry/ Fan/Heat	Each Group	Each Group
Temperature Setting	<ol style="list-style-type: none"> 1. Sets temperature for a single group. 2. Range of temperature setting (may vary depending on connected indoor unit) <ol style="list-style-type: none"> a. Auto/Cool/Dry: 65°F-86°F b. Heat: 47°F-86°F 3. Setting discharge outlet air temperature for supported indoor units. 	Each Group	Each Group
Discharge Air Temperature Setting	Sets temperature for supported ducted units	Each Group	Each Group
Fan Speed Setting	<ol style="list-style-type: none"> 1. Models with 3 air flow speed settings: High /Mid/Low/Auto 2. WindFree™ mode enable/disable 3. Motion Detection Sensor Control 4. Clean and Long reach function for supported indoor unit models. 	Each Group	Each Group
Air Flow Direction Setting	<ol style="list-style-type: none"> 1. Air flow 2-step direction (Swing/Stop) 2. Direct setting at a specific angle. 3. Air flow operation varies depending on the model. 	Each Group	Each Group

<i>Multi-Function Controller</i>			
<i>Item</i>	<i>Description</i>	<i>Operation</i>	<i>Display</i>
Scheduling	<ol style="list-style-type: none"> 1. Weekly and yearly schedule settings (maximum 8 yearly schedule groups) 2. Power ON/OFF, mode, temperature, and fan speed settings can be set. 3. Configurable “Temporary Hold”/override duration for changes made when a schedule has been programmed. 4. Maximum 49 total weekly and yearly schedule settings can be set. 5. Real-time clock function: current time, day display function 	Each Group	Each Group
Setback	<ol style="list-style-type: none"> 1. Four (4) configuration patterns can be set (Wake, Leave, Return, Sleep). 2. Specify time, heating and cooling set temperatures and mode. 	Each Group	Each Group
Button lock	<ol style="list-style-type: none"> 1. Button permission level setting (On/Off / Temperature setting / Mode button / Fan speed) 2. Temperature limit setting 3. After power reset, the setting value is restored 4. Various restriction capabilities 	Each Group	Each Group
Specified Function	Automatic stop setting (setting time range: 0-12 hours)	Each Group	Each Group

<u>Multi-Function Controller</u>			
<u>Item</u>	<u>Description</u>	<u>Operation</u>	<u>Display</u>
Service Mode	<ol style="list-style-type: none"> 1. Viewing/setting indoor unit option code 2. Viewing/setting indoor unit MAIN address 3. Viewing/setting indoor unit RMC address 4. Viewing indoor unit cycle data 5. Setting/Viewing temperature sensor compensation of the wired remote controller (-9°F~+9°F) 6. Viewing RPM compensation 7. Viewing/setting EEV stop step when indoor unit is thermal-off during heating mode 8. Viewing/setting filter reminder time interval (1000 hours, 2000 hours) 9. Viewing/setting indoor unit temperature sensor compensation during Heating (+2°F or +5°F) 10. Viewing the H/W option setting 11. Viewing wired remote controller software version 12. Viewing/setting individual louver lock 13. Viewing indoor unit status 14. Power Master Reset 15. Resetting ODU (K3) 16. Automatic air volume enable and status viewing (for supported indoor units) 	Each Unit	Each Unit
Blade	Setting individual blade positions on 4-Way Cassette (AM0**RN4DCH/AA, AC0**NN4DCH/AA, AJ0**TNNDCH/AA, JNH***NDT)	Each Unit	Each Unit
Error	When an error is currently occurring in the system, the afflicted unit and the error code are displayed	Each Group	Each Group
Permit / Prohibit Local Operation	Setting/releasing of simplified locking of remote control buttons	Each Group	N/A
Quiet Mode	Select the quiet mode to lower the fan noise level (for supported units)	Each Group	N/A
Room Temperature	Actual room temperature or set temperature can be displayed	Each Group	Each Group

<i>Multi-Function Controller</i>			
<i>Item</i>	<i>Description</i>	<i>Operation</i>	<i>Display</i>
Energy and Usage	<ol style="list-style-type: none"> 1. Display instantaneous power (current power use), weekly usage, monthly usage, and yearly usage, in graph format with year-over-year display option. <ol style="list-style-type: none"> a. The weekly display follows ISO 8601 standards. 2. Display weekly operating time, monthly operating time, yearly operating time, in graph format with year-over-year display option. 3. Target energy consumption and target operating times can be specified. When energy consumption or operating time has exceeded the target(s), an alarm popup will appear for notification. 	Each group	Each group

2.10 BACnet® GATEWAY 2.5 (MIM-B17BUN)

A. Function:

1. Easy control and monitoring through web browser (optimized for Internet Explorer). Individual/Group control of up to 256 indoor units including SAMSUNG ERV, air handlers, DVM Chiller, and DVM Chiller FCU Kits.
2. The BACnet® gateway shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 256 indoor units), or all indoor units (collective batch operation). This basic control set of operation controls for the BACnet® gateway shall include on/off, operation mode selection (auto, cool, heat, dry, and fan), temperature setting, fan speed setting, airflow direction setting, error email notification, temperature limitations, operation mode limitation, and online maintenance.
3. The BACnet® gateway shall support system error notification via email. The Data Management Server emailed errors shall include: error occurrence time, error code with description of error, effected equipment address, and current error status.
4. The BACnet® gateway shall support: system configuration, 1-day/daily/weekly scheduling, monitoring of operation status, online maintenance tool, operation superseding of the remote controllers, editable user defined control logic, and malfunction monitoring.
5. The BACnet® gateway shall allow maximum current setting control of each outdoor unit (DVM S Series AM****X*****AA only).
6. Schedule Control Function through web browser. Up to 256 schedule settings, weekly and dai-

- ly schedule setting, wireless/wired remote controller restriction setting. Digital Outputs can be incorporated into scheduling.
7. The Server shall allow configuration of unoccupied room settings for indoor units configured for unoccupied room control.
 8. Convenient digital display allows for easy set up.
 9. SD memory card slot for data storage and software updating.
 10. Available programmable logic to control the system based on preset monitor points. Specify various system control point inputs (indoor units, outdoor units, DI, DO) and operators (=, >, <, ≤, ≥, ≠) to manipulate system operation (indoor units, outdoor units, DI, DO) based on the status of the specified variables.
 11. Optional "weighted averaging" or "representative" setting for heat pump systems to provide optimal auto changeover while in Auto mode.
 12. Web Server Function with remote control (with a public IP address) via internet connection. No management software required – PC-independent management through web browser.
 13. 10 DI (Digital Input) ports available. Two digital input ports shall be for emergency shutdown with external contact control interface and 8 for other monitoring options (OPEN/CLOSE status). Full indoor unit control with simple contact input (Emergency/Lock). Digital inputs can be incorporated into control logics.
 14. 8 DO (Digital Output) terminals for monitoring and control options. 2 state output (Operation/Error) for synchronous control and monitoring. 6 general purpose outputs to control other components (on: 12VDC out; off: no voltage). Digital Outputs can be incorporated into control logics and scheduling.
 15. The Data Management Server shall have an optional 2D floorplan display that will allow uploading building floorplan images in JPG, GIF, or PNG file formats. The Data Management Server 2D floorplan shall support placement of indoor units onto the floorplan for simplified user control and monitoring. Maximum one image file per zone, maximum 32 zones can be created.

B. Connection:

1. DC 12V, 3A power provided by AC/DC adapter (input 110-240VAC 50/60Hz, provided with the BACnet® gateway)
2. LAN connection for BMS, web browser, SNET3 software connection
3. Communication connection: ON/OFF Controller(s) (MCM-A202DUN)
4. 16 AWG X 2 shielded cable between SAMSUNG equipment and controls is necessary for proper operation

5. Maximum number of RS485 connections to 1 BACnet® gateway:
 - (a) 75 ON/OFF Controllers (MCM-A202DUN)
 - (b) 80 DVM S Series Systems (AM****X****2AA) connected direct (5 ports, 16 systems per port)
 - (c) Maximum 128 indoor units (air handler and/or SAMSUNG ERV)
6. Upper level device connections: S-NET 3, BMS system (BACnet® IP), web client
7. MIM-B17BUN shall provide functions to monitor and control status of SAMSUNG DVM S Series systems (AM****X****2AA).
8. The Data Management Server shall support provide functions to monitor and control status of SAMSUNG DVM Plus II, Samsung DVM Plus III, Mini DVM, Free Joint Multi (MH***FXCA*A), and CAC (CH070/105/140CAV, DH105/140CAV, single zone systems) with installation of communication converter interface module per system (MIM-N01).
9. The Data Management Server shall support provide functions to monitor and control status of SAMSUNG CAC AC0***N**C*/AA (single zone systems) without installation of additional interface modules.

C. Dimensions:

1. The BACnet® gateway shall be approximately 9.4” x 10” x 2.6” in size with stainless steel front and LCD displays.

D. Control details:

<i>VRF BACnet® Gateway 2.5</i>			
<i>Item</i>	<i>Description</i>	<i>Operation</i>	<i>Display</i>
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Auto/Cool/Dry/ /Fan/Heat	Each Group	Each Group
Temperature Setting	1. Sets the temperature for a single group. Range of temperature setting <ol style="list-style-type: none"> a. Auto/Cool/Dry: 65°F-86°F b. Heat: 47°F-86°F 2. Set discharge air temperature for Applicable Samsung duct units that have been configured for discharge air temperature control. Range of temperature setting: <ol style="list-style-type: none"> a. Cool/Dry mode: 46°F - 64°F b. Heat mode: 64°F - 86°F 	Each Group	Each Group

<i>VRF BACnet® Gateway 2.5</i>			
<i>Item</i>	<i>Description</i>	<i>Operation</i>	<i>Display</i>
Fan Speed Setting	Models with 3 air flow speed settings: High /Mid/Low	Each Group	Each Group
Air Flow Direction Setting	<ol style="list-style-type: none"> 1. Air flow 2-step direction (Swing/Stop) 2. Direct setting at a specific angle. 3. Air flow operation varies depending on the model. 	Each Group	Each Group
Web Server Function	<ol style="list-style-type: none"> 1. Remote control with the public IP address 2. No management software required – PC-independent management 	Each Group	Each Group
Accessible level / Dynamic user security Management	<ol style="list-style-type: none"> 1. Wireless/wired remote controller restriction setting 2. Specify the scope of control and monitoring unit on a per-user 3. 3 accessible levels: Admin/Manager/User 	Each Group	Each Group
Error	<ol style="list-style-type: none"> 1. When an error is currently occurring in the system(s), the afflicted unit and the error code are displayed 2. Error notification via email 	Each Group	Each Group
Schedule Operation	<ol style="list-style-type: none"> 1. Up to 256 schedule settings 2. Weekly and daily schedule setting 	Each Group	Each Group
Power Distribution System	<ol style="list-style-type: none"> 1. Power distribution to 256 indoor units. 2. Remote data query in 1-day units 3. File saving in Microsoft Excel format. 4. Power distribution data storage for one year 5. MIM-B16N or MIM-B16UN required for power use measurements 	Each Group	Each Group
External Contact Interface	<ol style="list-style-type: none"> 1. Full indoor unit control with simple contact input (Emergency/Lock) 2. State output (Operation/Error) for synchronous control 3. 10 digital outputs (2 reserved) / 8 digital inputs (2 reserved) 	Each Channel	Each Channel
Smart Central Management	<ol style="list-style-type: none"> 1. Control & monitoring zone edition 2. Wireless/wired remote control restriction 3. Temperature limit setting 4. Operation mode restriction 	Each Group	Each Group

<u>VRF BACnet® Gateway 2.5</u>			
<u>Item</u>	<u>Description</u>	<u>Operation</u>	<u>Display</u>
User editable control logic	<ol style="list-style-type: none"> 1. User can edit control logic with arithmetic/conditional operators and parameters. 2. Efficient energy saving realization for various operation conditions. 3. EHP/ERV/AHU parameters + AND/OR + Arithmetic equation Function 	Each Group	Each Group
Data back-up/useful history management	<ol style="list-style-type: none"> 1. Important data is stored in SD memory card (settings, schedules, errors, operation data, energy data, user settings, etc.) 2. Record the operation history and error history 	Each Group	Each Group
Unoccupied Room Control Configuration	<ol style="list-style-type: none"> 1. Specify unoccupied room settings for applicable indoor units <ol style="list-style-type: none"> a. Mode b. Fan speed c. Set temperature 	Each Group	-
DVM Chiller Control	<ol style="list-style-type: none"> 1. Operation ON/OFF 2. Mode: Heat, cool, cool storage, hot water 3. Operation pattern: standard, rotation, efficiency 4. Enable/disable Water Law 5. Enable/disable quiet mode 6. Forced fan mode 7. Demand/maximum current control (50~100% of design current) 	Each Group	Each Group

<u>VRF BACnet® Gateway 2.5</u>		
<u>Input Variables (Control)</u>	<u>Output Variables (Monitor)</u>	
On/Off control	On/Off state	In/out contact state
Operation mode	Operation mode	Emergency Stop
Temperature setting	Set/Room temperature	Error code
Fan speed/direction	Fan speed/direction	Indoor unit run time
ERV operation mode	ERV operation mode	DO/DI Status
ERV fan speed	ERV fan speed	SPI setting
Filter alarm reset	Filter alarm	DVM Chiller Chilled water temperature

<u><i>VRF BACnet® Gateway 2.5</i></u>		
<u><i>Input Variables (Control)</i></u>	<u><i>Output Variables (Monitor)</i></u>	
User control restriction	User control restriction	Error status
Operation mode lock	Thermal Off/On	
Set temperature limit	Power distribution	
Emergency stop	Operation mode lock	
Output contact control	Set temperature limit	
DO ON/OFF	Human Sensor (select units)	
Duct unit discharge air temperature set temperature (select units)	Duct unit discharge air temperature (select units)	
DVM Chiller Chilled water temperature	DVM Chiller demand limit setting	
DVM Chiller set temperature	Operation hours	
DVM Chiller demand limit setting	DVM Chiller Water Law	
DVM Chiller Water Law	DVM Chiller set temperature	
DVM Chiller quiet mode	DVM Chiller quiet mode	

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 and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install and connect pre-charged 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 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 238129

SECTION 238233 - CONVECTORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hydronic convectors.

1.2 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 details and dimensions of custom-fabricated enclosures.
 - 4. Indicate location and size of each field connection.
 - 5. Indicate location and arrangement of piping valves and specialties.
 - 6. Include enclosure joints, corner pieces, access doors, and other accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER CONVECTORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
 - 1. Beacon Morris
 - 2. Sterling
 - 3. Trane
 - 4. Zehnder Rittling
- B. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and rolled into cast-iron or brass headers with inlet/outlet and air vent; steel side plates and supports. Factory-pressure-test element at minimum **100 psig (690 kPa)**.

- C. Front and Top Panel: Minimum **0.0528-inch- (1.35-mm-)** thick steel with exposed corners rounded; removable front panels with tamper-resistant fasteners braced and reinforced for stiffness.
- D. Wall-Mounted Back and End Panels: Minimum **0.0428-inch- (1.1-mm-)** thick steel.
- E. Support Brackets: Locate at maximum **36-inch (914-mm)** spacing to support front panel and element.
- F. Insulation: **1/2-inch- (13-mm-)** thick, fibrous glass on inside of the back of the enclosure.
- G. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.
- H. Damper: Knob-operated internal damper.
- I. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size **6 by 7 inches (150 by 175 mm)**, integral with enclosure.
- J. Enclosure Style: Sloped top.
 - 1. Front Inlet Grille: Punched louver; painted to match enclosure.
 - 2. Top Outlet Grille: Punched louver; painted to match enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install convectors level and plumb.
- B. Install valves within reach of access door provided in enclosure.
- C. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.
- D. Install piping within pedestals for freestanding units.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water convectors and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
 - 2. Install shutoff valve on inlet; install strainer, steam trap, and shutoff valve on outlet.

- C. Install control valves as required by Section 230923.11 "Control Valves."
- D. Install piping adjacent to convectors to allow service and maintenance.
- E. Ground electric convectors according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field 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 convectors to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Convectors will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238233

SECTION 238236 - FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hydronic and electric finned-tube radiation heaters.

1.3 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 details and dimensions of custom-fabricated enclosures.
 - 4. Indicate location and size of each field connection.
 - 5. Indicate location and arrangement of piping valves and specialties.
 - 6. Indicate location and arrangement of integral controls.
 - 7. Include enclosure joints, corner pieces, access doors, and other accessories.
 - 8. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.
- E. Color Samples for Verification: For each type of exposed finish.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor 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. Structural members, including wall construction, to which finned-tube radiation heaters will be attached.
 2. Method of attaching finned-tube radiation heaters to building structure.
 3. Penetrations of fire-rated wall and floor assemblies.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 ELECTRIC FINNED-TUBE RADIATION HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
1. Berko Electric Heating; a division of Marley Engineered Products.
 2. Chromalox Inc.; a division of Emerson Electric Company.
 3. Markel Products; a division of TPI Corporation.
 4. QMark Electric Heating; a division of Marley Engineered Products.
- B. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.
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.
- C. Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded to fins, with high-temperature cutout and sensor running the full length of the element. Element supports shall eliminate thermal expansion noise.
- D. Rust-Resistant enclosure: Minimum 0.064-inch powder coated steel.
- E. Support Brackets: Locate at maximum **36-inch (914-mm)** spacing to support front panel and element.
- F. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.
- G. Enclosure Style: Sloped top.
1. Bottom Inlet Grille: Punched louver; painted to match enclosure.
 2. Top Outlet Grille: Punched louver; painted to match enclosure.
- H. Accessories: Integral disconnect switch, filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

2.2 HOT-WATER FINNED-TUBE RADIATION HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
 - 1. Vulcan
 - 2. Modine
 - 3. Sterling
 - 4. Trane
 - 5. Zehnder Rittling
- B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."
- C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.
- D. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.
- E. Front Panel: Minimum 0.0781-inch- (14 gauge) thick steel.
- F. Wall-Mounted Back Panel: Minimum 0.05-inch- (18 gauge) thick steel, full height, with full-length channel support for front panel without exposed fasteners.
- G. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.
- H. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.
- I. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure.
- J. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic-piping and electrical connections to verify actual locations before installation of finned-tube radiation heaters.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FINNED-TUBE RADIATION HEATER INSTALLATION

- A. Install units level and plumb.
- B. Install enclosure continuously around corners, using outside and inside corner fittings.
- C. Join sections with splice plates and filler pieces to provide continuous enclosure.
- D. Install access doors for access to valves.
- E. Install enclosure continuously from wall to wall.
- F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.
- G. Install valves within reach of access door provided in enclosure.
- H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."
 - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Section 230923.11 "Control Valves."
- D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.
- E. Ground electric finned-tube radiation heaters according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 238236

SECTION 238239.13 - CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cabinet unit heaters with centrifugal fans and hot-water coils.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. DDC: Direct digital control.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- 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 Initial Selection: Finish colors for units with factory-applied color finishes.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.6 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
 - 1. Beacon Morris
 - 2. Sterling
 - 3. Trane
 - 4. Zehnder Rittling

2.2 DESCRIPTION

- A. Factory-assembled and -tested unit complying with AHRI 440.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 COIL SECTION INSULATION

- A. Insulation Materials: ASTM C 1071; surfaces exposed to airstream shall have erosion-resistant coating to prevent erosion of glass fibers.
 - 1. Thickness: 1/2 inch (13 mm).
 - 2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F (0.037 W/m x K at 24 deg C) mean temperature.
 - 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - 4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.4 CABINETS

- A. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
 - 1. Vertical Unit, Exposed Front Panels: Minimum 0.0677-inch- thick galvanized sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
 - 2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0677-inch- thick galvanized sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
 - 3. Recessed Flanges: Steel, finished to match cabinet.
 - 4. Control Access Door: Key operated.
 - 5. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet 6 inches high with leveling bolts.
 - 6. Extended Piping Compartment: 8-inch- wide piping end pocket.

2.5 FILTERS

- A. Minimum Arrestance: And a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Glass Fiber Treated with Adhesive: 80 percent arrestance and MERV 5.

2.6 COILS

- A. 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.

2.7 CONTROLS

- A. Fan and Motor Board: Removable.
 - 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.
- B. Factory, Hot-Water Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
 - 1. Two-way, two-position control valve.
 - 2. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.

3. Automatic Flow-Control Valve: Brass or ferrous-metal body, 300-psig (2068-kPa) working pressure at 250 deg F (121 deg C), with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow within plus or minus 10 percent of differential pressure range of 2 to 80 psig (13.8 to 552 kPa).
 4. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig (860-kPa) minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 (DN 15) threaded pipe and full-port ball valve in strainer drain connection.
 5. Wrought-Copper Unions: ASME B16.22.
- C. Control devices and operational sequences are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- D. Electrical Connection: Factory-wired motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- C. 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. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
- E. Comply with safety requirements in UL 1995.
- F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."
- G. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of cabinet unit heater. Steam specialties are specified in Section 232216 "Steam and Condensate Piping Specialties."
- H. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 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.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

LaBella Associates, D.P.C.
Project No. 2221723

Academic Innovation Hub
Work Force Development Training
Niagara University

April 2024

END OF SECTION 238239.13

SECTION 238316 - RADIANT-HEATING HYDRONIC PIPING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes radiant-heating piping, including the following:

1. PEX-A pipe and fittings
2. Distribution manifolds
3. Piping specialties
4. Controls

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.

B. Shop Drawings: Provide system sizing and show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure. Include engineering report indicated pipe size, lengths, flows and heat output capacities.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 WARRANTIES

A. Manufacturer's Warranty: Standard transferable limited warranty against defects in materials and manufacturing.

1. Warranty Period for Tubing: 30 years.
2. Warranty Period for Manifolds and Fittings: 2 years.
3. Warranty Period for Controls and Electrical Components: 2 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:
1. Mr. PEX
 2. Upnor
 3. Watts

2.2 PEX-A PIPE AND FITTINGS

- A. Pipe Material: PEX-A plastic bonded to a welded aluminum tube according to ASTM F876 and ASTM F877.
- B. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at 104 deg F according to DIN 4726.
- C. Fittings: ASTM F1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).
- D. Flame-Spread and Smoke-Developed Indices: 25 and 50 or less, respectively, tested according to ASTM E84.
- E. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.

2.3 DISTRIBUTION MANIFOLDS

- A. Manifold: Minimum NPS 1, brass.
- B. Main Shutoff Valves:
1. Factory installed on supply and return connections.
 2. Three-piece body.
 3. Body: Brass or bronze.
 4. Ball: Chrome-plated bronze.
 5. Seals: PTFE.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 deg F.
- C. Manual Air Vents:
1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Key furnished with valve, or screwdriver bit.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/8.

6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

D. Balancing Valves:

1. Body: Bronze, ball or plug, or globe cartridge type.
2. Ball or Plug: Brass or stainless steel.
3. Globe Cartridge and Washer: Brass with EPDM composition washer.
4. Seat: PTFE.
5. Differential Pressure Gage Connections: Integral seals for portable meter to measure loss across calibrated orifice.
6. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
7. CWP Rating: Minimum 125 psig.
8. Maximum Operating Temperature: 250 deg F.

E. Zone Control Valves:

1. Body: Bronze, ball or plug, or globe cartridge type.
2. Ball or Plug: Brass or stainless steel.
3. Globe Cartridge and Washer: Brass with EPDM composition washer.
4. Seat: PTFE.
5. Actuator: Replaceable electric motor.
6. CWP Rating: Minimum 125 psig.
7. Maximum Operating Temperature: 250 deg F.

F. Thermometers:

1. Mount on supply and return connections.
2. Case: Dry type, metal or plastic, 2-inch diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, connecting element and pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Plastic.
8. Connector: Rigid, back type.
9. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem.
10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

G. Mounting Brackets: Copper, or plastic- or copper-clad steel, where in contact with manifold.

H. Manifold Cabinets:

1. Constructed of 20-gauge hot dipped galvanized steel, with knockouts on the sides and tops for routing of piping and tubing.
2. Durable white finish.
3. Latching door.
4. Adjustable manifold mounting brackets.
5. Removable front section for installation.

6. Recessed mounting

2.4 PIPING SPECIALTIES

A. Cable Ties:

1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
2. Minimum Width: 1/8 inch.
3. Tensile Strength: 20 lb, minimum.
4. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

B. Aluminum transfer plates

1. Extruded aluminum heat transfer plates approximately 4 feet long by 3.5 inches wide with extruded clip for 3/8" or 1/2" pex. Panels shall have pre-punched mounting holes.

2.5 CONTROLS

A. Wall-Mounted Thermostat:

1. Minimum temperature range from [50 to 90 deg F (10 to 32 deg C)] <Insert temperature range>.
2. Manually operated with on-off switch.
3. Day and night setback and clock program with minimum four periods per day.
4. Operate pumps or open zone control valves if room temperature falls below the thermostat setting, and stop pumps or close zone control valves when room temperature rises above the thermostat setting.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Install the following types of radiant-heating piping for the applications described:

1. Piping in Interior Concrete Floors: PEX-A.
2. Piping under wood floors: PEX-A with aluminum heat transfer plates.

3.2 INSTALLATION

- #### 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 Shop Drawings or coordination drawings.

- B. Manufacturer shall supply computer calculations, job specific scale piping layouts, and details for installation.
- C. Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.
- D. Connect radiant piping to manifold in a reverse-return arrangement.
- E. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.
- F. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Section 083113 "Access Doors and Frames."
- G. See Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties" for pipes and connections to hydronic systems and for glycol-solution fill requirements.
- H. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials according to Section 078413 "Penetration Firestopping."
- I. Piping in Interior Reinforced-Concrete Floors:
 - 1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
 - 2. Space cable ties a maximum of 18 inches o.c. and at center of turns or bends.
 - 3. Maintain 2-inch minimum cover.
 - 4. Install a sleeve of 3/8-inch- thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 5. Maintain minimum 40-psig pressure in piping during concrete placement and continue for 24 hours after placement.
- J. Piping in Level Fill Concrete Floors (Not Reinforced):
 - 1. Secure piping in concrete floors by attaching pipes to subfloor using tracks, clamps, or staples.
 - 2. Space tracks, clamps, or staples a maximum of 18 inches o.c. and at center of turns or bends.
 - 3. Maintain 3/4-inch minimum cover.
 - 4. Install a sleeve of 3/8-inch- thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 5. Maintain minimum 40-psig pressure in piping during the concrete pour and continue for 24 hours during curing.
- K. Piping in staple up wood floor systems:

1. Secure piping by attaching pipes to subfloor using extruded aluminum heat transfer plates with channel to snap in tubing. Screw plates to wood floor. Leave ¼” gap between plates. Support tubing not in plates with staples or clips.
 2. Space tracks, clamps, or staples a maximum of 8 inches o.c. and at center of turns or bends.
 3. Installation shall conform to manufacturer’s installation handbook.
- L. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.
- M. After system balancing has been completed, mark balancing valves to permanently indicate final position.
- N. Perform the following adjustments before operating the system:
1. Open valves to fully open position.
 2. Check operation of automatic valves.
 3. Set temperature controls so all zones call for full flow.
 4. Purge air from piping.
- O. After concrete has cured as recommended by concrete or plaster supplier, operate radiant-heating system as follows:
1. Start system heating at a maximum of 10 deg F above the ambient radiant-panel temperature and increase 10 deg F each following day until design temperature is achieved.

END OF SECTION 238316

SECTION 260000 – ELECTRICAL SERVICE ENTRANCE

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. Division 01 Allowances for associated electric utility allowance.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical service entrance utility equipment and installation.

1.3 SYSTEM DESCRIPTION

- A. Electrical Contractor shall carry all costs associated with upgrade of utility service from existing pole-mounted transformer overhead 120/240-volt, 1-phase, 200-amp service to new pole-mounted transformer underground 208Y/120-volt, 3-phase 400-amp service.
 - 1. Electric Utility cost to include electrical service entrance utility equipment (pole-mounted accessories, primary cabling, transformer, transformer pad, CT meter, CT meter mounting) and installation.
 - 2. Costs billed by electric utility are covered by the electric utility allowance.
 - 3. All other associated costs (prep work, coordination, scheduling) shall be covered under base bid by contractor.

1.4 COORDINATION

- A. Utility Company Contact
 - 1. Ms. Joyce Stafford
 - a. Phone (Office): 315-468-7519
 - b. Email: Joyce.Stafford@nationalgrid.com
 - c. Work Request Number: 30810070
- B. Coordinate arrangement, mounting, and support of utility electrical equipment.
- C. Coordinate installation in accordance with utility company's rules and regulations.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Department or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Electric power for existing well building shall not be interrupted until new water filtration building and associated water process equipment systems are functional and approved by the
 - 2. Notify Department no fewer than two days in advance of proposed interruption of electrical systems.
 - 3. Indicate method of providing temporary utilities.
 - 4. Do not proceed with interruption of electrical systems without Department's written permission.
 - 5. Comply with NFPA 70E.

END OF SECTION 260000

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Concrete work.
6. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data:
 1. For sleeve seals.
 2. For concrete.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, cast anchor-bolt inserts into bases, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- E. Coordinate concrete selection and application with concrete specific in Division 03 Section "Cast-In-Place Concrete".

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 CONCRETE WORK

- A. For cast-in-place or pre-formed: Comply with requirements in Division 03 Section "Cast-In-Place Concrete".

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Owner, or Owner's representative, no fewer than **two** days in advance of proposed interruption of electrical systems.
 2. Indicate method of providing temporary utilities.
 3. Do not proceed with interruption of electrical systems without Owner's, or Owners representative, written permission.
 4. Comply with NFPA 70E.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.

- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 CONCRETE WORK

- A. Apply concrete work that complies with requirements in Division 03 Section "Cast-In-Place Concrete".

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Fire-alarm wire and cable.
4. Connectors, splices, and terminations rated 600 V and less.

- B. Related Requirements:

1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Alpha Wire Company.

2. [American Bare Conductor.](#)
3. [Belden Inc.](#)
4. [Cerro Wire LLC.](#)
5. [Encore Wire Corporation.](#)
6. [General Cable Technologies Corporation.](#)
7. [Okonite Company \(The\).](#)
8. [Service Wire Co.](#)
9. [Southwire Company.](#)
10. [WESCO.](#)

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:

1. [Alpha Wire Company.](#)
2. [American Bare Conductor.](#)
3. [Belden Inc.](#)
4. [Encore Wire Corporation.](#)
5. [General Cable Technologies Corporation.](#)
6. [Okonite Company \(The\).](#)
7. [Service Wire Co.](#)
8. [Southwire Company.](#)
9. [WESCO.](#)

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.

4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

- F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.

- H. Armor: Steel, interlocked.

2.3 FIRE-ALARM WIRE AND CABLE

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. [Allied Wire & Cable Inc.](#)
2. [CommScope, Inc.](#)
3. [Comtran Corporation.](#)
4. [Draka Cableteq USA; a Prysmian Group company.](#)
5. [Genesis Cable Products; Honeywell International, Inc.](#)
6. [Radix Wire.](#)
7. [Rockbestos-Suprenant Cable Corp.](#)
8. [Superior Essex Inc.](#)
9. [West Penn Wire.](#)

- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

1. **Lead Content:** Less than 300 parts per million.

- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. 3M Electrical Products.
 2. AFC Cable Systems; a part of Atkore International.
 3. Gardner Bender.
 4. Hubbell Power Systems, Inc.
 5. Ideal Industries, Inc.
 6. ILSCO.
 7. NSi Industries LLC.
 8. O-Z/Gedney; a brand of Emerson Industrial Automation.
 9. Service Wire Co.
 10. TE Connectivity Ltd.
 11. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, steel with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 1. Material: tin-plated Aluminum.
 2. Type: One hole with standard barrels.
 3. Termination: Crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 14 AWG and smaller; stranded for No. 12 AWG and larger.
- C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRING

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 283111 "Digital, Addressable Fire-Alarm System."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system.
 3. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 4. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
 5. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 1. FOR CONNECTIONS TO OLD ALUMINUM CONDUCTORS (Non-AA-8000 Alloy type): Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling" or Section 260500 "Common Work Results".

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping" or Section 260500 "Common Work Results".

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.

- C. Prepare test and inspection reports to record the following:
1. Procedures used.
 2. Results that comply with requirements.
 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Backboards.
 - 2. Category 6 balanced twisted pair cable.
 - 3. Balanced twisted pair cabling hardware.
 - 4. Control-circuit conductors.
 - 5. Identification products.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. 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.
- D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

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. 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.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. 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.
- E. RoHS compliant.

2.2 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches or dimension called for on Drawings. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."
- B. Painting: Paint plywood on all sides and edges with eggshell paint. Comply with requirements in Section 099123 "Interior Painting."

2.3 CATEGORY 6 BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Inc.
 - 2. CommScope, Inc.
 - 3. General Cable; Prysmian Group North America.
 - 4. Mohawk; a division of Belden Networking, Inc.
 - 5. Superior Essex Inc.; subsidiary of LS Corp.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100-ohm, 23 AWG solid copper.
 - 1. Lead Content: Less than 300 parts per million.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).

- F. Cable Rating: Plenum.
- G. Jacket: White thermoplastic.

2.4 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden Inc.
 - 2. CommScope, Inc.
 - 3. General Cable; Prysmian Group North America.
 - 4. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - 5. Leviton Manufacturing Co., Inc.
 - 6. Mohawk; a division of Belden Networking, Inc.
 - 7. Panduit Corp.
 - 8. Superior Essex Inc.; subsidiary of LS Corp.
- C. General Requirements for Balanced Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Source Limitations: Obtain balanced twisted pair cable hardware from same manufacturer as balanced twisted pair cable, from single source.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
 - 3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
 2. Patch cords shall have color-coded boots for circuit identification.
- H. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
 2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
 3. Marked to indicate transmission performance.
- I. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
 2. Designed to snap-in to a patch panel or faceplate.
 3. Standards:
 - a. Category 6, unshielded balanced twisted pair cable shall comply with IEC 60603-7-4.
 4. Marked to indicate transmission performance.
- J. Faceplate:
1. Two port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
 2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
- K. Legend:
1. Machine printed, in the field, using adhesive-tape label.
 2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 CONTROL-CIRCUIT CONDUCTORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [Encore Wire Corporation.](#)
 2. [General Cable; General Cable Corporation.](#)
 3. [Service Wire Co.](#)
 4. [Southwire Company.](#)

- B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

2.6 SOURCE QUALITY CONTROL

- A. Factory test twisted pair cables according to TIA-568-C.2.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. 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 modified in this Section.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 - 2. Outlet boxes for cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 - 3. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.

2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard if entering the room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. 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 between termination, tap, or junction points.
 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and 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 and not more than 6 inches 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.
 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. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
 15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
- C. Balanced Twisted Pair Cable Installation:
1. Comply with TIA-568-C.2.

2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
 3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.
- D. Installation of Control-Circuit Conductors:
1. Install wiring in raceways.
 2. Use insulated spade lugs for wire and cable connection to screw terminals.
 3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
 3. 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:
1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.

- b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
 - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:

- 1. Class 1 remote-control and signal circuits; No 14 AWG.
- 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
- 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Ground rods.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning & Grounding.
7. ILSCO.
8. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.
- I. Ground Rod Connectors: Exothermically Welded Connection.
- J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- L. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- N. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with stainless-steel bolts.
 - a. Material: Tin-plated aluminum.
 - b. Listed for direct burial.
- O. **Lead Content**: Less than 300 parts per million.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad Zinc-coated steel; 5/8 inch by 8 feet.
- B. Accessories:
 - 1. Test Well: 9-inch round with locking cover, material HDPE with knockouts for conductors.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Conductors: Green-colored insulation.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors shall be connected to the ground bus. Grounding electrode conductor(s) shall be connected to the neutral bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. 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.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of test well, and shall be at least 12 inches deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Steel slotted support systems.
 - 2. Conduit and cable support devices.
 - 3. Support for conductors in vertical conduit.
 - 4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Slotted support systems, hardware, and accessories.
2. Clamps.
3. Hangers.
4. Sockets.
5. Eye nuts.
6. Fasteners.
7. Anchors.
8. Saddles.
9. Brackets.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Allied Tube & Conduit; a part of Atkore International.](#)
 - b. [B-line, an Eaton business.](#)
 - c. [ERICO International Corporation.](#)
 - d. [Flex-Strut Inc.](#)
 - e. [GS Metals Corp.](#)
 - f. [G-Strut.](#)
 - g. [Haydon Corporation.](#)
 - h. Metal Ties Innovation.

- i. [Thomas & Betts Corporation; A Member of the ABB Group.](#)
 - j. [Unistrut; Part of Atkore International.](#)
 - k. [Wesanco, Inc.](#)
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 4. Channel Width: 1-5/8 inches.
 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - 1) [Hilti, Inc.](#)
 - 2) [ITW Ramset/Red Head; Illinois Tool Works, Inc.](#)
 - 3) [MKT Fastening, LLC.](#)
 - 4) [Simpson Strong-Tie Co., Inc.](#)
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) [B-line, an Eaton business.](#)
 - 2) [Empire Tool and Manufacturing Co., Inc.](#)

- 3) [Hilti, Inc.](#)
 - 4) [ITW Ramset/Red Head; Illinois Tool Works, Inc.](#)
 - 5) [MKT Fastening, LLC.](#)
3. Concrete Inserts: Stainless-steel, Type 304 Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Outdoors: Apply hangers and supports products as specified below unless otherwise indicated:
 1. Exposed: Galvanized Steel.
- B. Indoors: Apply hangers and support products as specified below unless otherwise indicated:
 1. Exposed, not subject to corrosive environment or wet location: Galvanized Steel.
 2. Exposed, and subject wet location but not corrosive environment: Stainless Steel Type 304.
- C. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA 101
- D. Comply with requirements in Section 078413 "Penetration Firestopping" or Section 260500 "Common Work Results" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- E. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- F. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- G. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- H. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

- B. Field Welding: Comply with AWS D1.1/D1.1M.

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 minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, Enclosures, and Cabinets.

1.3 DEFINITIONS

- A. ARMC: Aluminum Rigid Metal Conduit.
- B. RMC: Rigid Metal Conduit.
- C. IMC: Intermediate Metal Conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. [AFC Cable Systems, Inc.](#)
 - 2. [Allied Tube & Conduit.](#)
 - 3. [Anamet Electrical, Inc.](#)
 - 4. [Electri-Flex Company.](#)
 - 5. [FSR Inc.](#)

6. [O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.](#)
7. [Picoma Industries.](#)
8. [Republic Conduit.](#)
9. [Robroy Industries.](#)
10. [Southwire Company.](#)
11. [Thomas & Betts Corporation, A Member of the ABB Group.](#)
12. [Western Tube and Conduit Corporation.](#)
13. [Wheatland Tube Company.](#)

- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RMC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- I. Joint Compound for IMC, RMC, or ARMC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. [Products:](#) Subject to compliance with requirements, provide one of the following:

1. [AFC Cable Systems, Inc.](#)
2. [Anamet Electrical, Inc.](#)
3. [Arneo Corporation.](#)
4. [CANTEX INC.](#)
5. [CertainTeed Corporation.](#)
6. [Condux International, Inc.](#)
7. [Electri-Flex Company.](#)
8. [Kraloy.](#)
9. [Lamson & Sessions;](#) Carlon Electrical Products.
10. [Niedax Inc.](#)

11. [RACO; Hubbell.](#)
 12. [Thomas & Betts Corporation, A Member of the ABB Group.](#)
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: Comply with UL 514B.
- G. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. [Products:](#) Subject to compliance with requirements, provide one of the following:
1. [Cooper B-Line, Inc.; a division of Cooper Industries.](#)
 2. [Hoffman; a brand of Pentair Equipment Protection.](#)
 3. [MonoSystems, Inc.](#)
 4. [Square D.](#)
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. MonoSystems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Adalet.
 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 3. EGS/Appleton Electric.
 4. Erickson Electrical Equipment Company.
 5. FSR Inc.
 6. Hoffman; a brand of Pentair Equipment Protection.
 7. Hubbell Incorporated.
 8. Kraloy.
 9. Milbank Manufacturing Co.
 10. MonoSystems, Inc.
 11. Oldcastle Enclosure Solutions.
 12. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 13. RACO; Hubbell.
 14. Robroy Industries.
 15. Spring City Electrical Manufacturing Company.
 16. Stahlin Non-Metallic Enclosures.
 17. Thomas & Betts Corporation, A Member of the ABB Group.
 18. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- I. Box extensions and/or mud-rings/plaster rings used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- K. Gangable boxes are allowed.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: RMC, IMC or RNC, Type EPC-80-PVC.
 - 2. Concealed Conduit, Aboveground: RMC, IMC or RNC, Type EPC-40-PVC.
 - 3. Underground Conduit: RNC, Type EPC-80-PVC, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed (unfinished areas), Not Subject to Physical Damage: EMT.
 - 2. Exposed (Renovations: finished areas with gypsum board walls), Not Subject to Physical Damage: Fished MC cable.
 - 3. Exposed (Renovations: finished areas with solid walls), Not Subject to Physical Damage: Surface Raceways.

4. Exposed and Subject to Physical Damage: RMC or IMC. Raceway locations include the following:
 - a. Loading dock.
 - b. Below 8' AFF in corridors used for traffic of mechanized carts and pallet-handling units.
 - c. Corridors used for traffic of forklifts.
 - d. Mechanical rooms.
 - e. Elevator machine rooms, shafts, and pits.
 5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 7. Damp or Wet Locations: RMC or IMC.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size, except for switch legs and final device box connections which may be 1/2-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.
- 3.2 INSTALLATION
- A. Coordinate installation of mud-ring/plaster-ring raised portion with general trade contractor to match drywall depth to provide flush installation of devices. Provide correctly raised mud-rings/plaster-rings as required.

- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- I. Support conduit within 12 inches of enclosures to which attached.
- J. Raceways penetrations in roofs:
 - 1. Provide penetration of individual raceways and cables with flexible boot-type flashing units. Provide roof flashing, cut and patch roof to match existing.
 - 2. Install in coordination with roofing and HVAC work.
 - 3. Coordinate with owner to provide installation that maintains existing roof warranty.
 - 4. Seal and waterproof penetrations.
- K. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- L. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- M. 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.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- U. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.

- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Y. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Refer to Section 260543 "Underground Ducts and Raceways for Electrical Systems.

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling" or Section 260500 "Common Work Results".

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Type PVC raceways and fittings.
 - 2. Fittings for conduit, tubing, and cable.
 - 3. Solvent cements.
 - 4. Duct accessories.
 - 5. Handholes and boxes for exterior underground wiring.
 - 6. Duct sealing.

1.2 DEFINITIONS

- A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.
- B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.
- C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.
- D. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Type PVC raceways and fittings.
 - 2. Fittings for conduit, tubing, and cable.
 - 3. Solvent cements.
 - 4. Duct accessories.
 - 5. Handholes and boxes for exterior underground wiring.
 - 6. Duct sealing.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturers' published instructions.
- B. Field Reports:
 - 1. Factory Test Reports: For handholes and boxes.
 - 2. Manufacturer's field reports for field quality-control support.

PART 2 - PRODUCTS

2.1 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL CCN DZYR.

B. Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Calconduit; Atkore International.
 - c. JM Eagle.
 - d. Opti-Com Manufacturing Network, Inc (OMNI).
 - e. Topaz Lighting & Electric.
2. Dimensional Specifications: Schedule 80.
3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - b. Markings: For use with maximum 90 deg C wire.

2.2 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.

2.3 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: In accordance with Section 260553 "Identification for Electrical Systems."

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
 - a. ASTM C858 for design and manufacturing processes.
 - b. SCTE 77.

A. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover:

1. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company; brand of Hubbell Utility Solutions; Hubbell Incorporated.
 - b. MacLean Highline.
 - c. NewBasis.
 - d. Oldcastle Infrastructure Inc.; CRH Americas.
 - e. Quazite; brand of Hubbell Utility Solutions; Hubbell Incorporated.
3. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and installed location.
 - a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
 - b. Cover Legend: Molded lettering, "ELECTRIC/COMMUNICATION" as indicated for each service
5. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering ducts for secure, fixed installation in enclosure wall.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings must mate with entering duct for secure, fixed installation in enclosure wall.
8. Handholes 12 inch wide by 24 inch long (300 mm wide by 600 mm long) and larger must have factory-installed inserts for cable racks and pulling-in irons.
9. Options:
 - a. Color: Green.
 - b. Provide divider to separate electrical and communication services.

2.5 DUCT SEALING

- 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. ABB, Electrification Business.
 - 2. CommScope, Inc.
 - 3. TE Connectivity Ltd.
- B. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Compound must be capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Duct sealing compound must be removable without damaging ducts or cables.
- C. Inflatable Duct-Sealing System: Wraparound inflatable bladder that seals ducts that are empty or containing conductors against air and water infiltration. System is suitable for use in steel, plastic, or concrete ducts and penetrations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing."

3.2 SELECTION OF UNDERGROUND DUCTS

- A. Duct for Electrical Feeders 600 V and Less: PVC-80, direct buried unless otherwise indicated.
- B. Duct for Electrical Branch Circuits: PVC-80, direct buried unless otherwise indicated.

3.3 SELECTION OF UNDERGROUND ENCLOSURES

- A. Handholes and Boxes:

1. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
2. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
3. Cover design load must not exceed load rating of handhole or box.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Restore area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures in accordance with "Cutting and Patching" Article in Section 017300 "Execution."

3.5 INSTALLATION OF DUCTS AND DUCT BANKS

- A. Reference Standards:
 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
 2. Consult Architect for resolution of conflicting requirements.
- B. Special Techniques:
 1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
 2. Raceway, bends, and fittings in single duct run or duct bank must be of same type.
 3. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
 4. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to manhole or handhole.
 5. Install expansion fitting near center of straight line duct with calculated expansion of more than 3/4 inch.
 6. Curves and Bends:

- a. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with minimum radius of 48 inch, both horizontally and vertically, at other locations unless otherwise indicated.
 - b. Field bending must be in accordance with NFPA 70 minimum radii requirements, except bends over 45 degrees must be made with minimum radius of 48 inch. Use only equipment specifically designed for material and size involved. Use PVC heating bender for bending PVC conduit.
 - c. Duct must have maximum of 180 degrees of bends between pull points.
7. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.
- a. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch below grade or floor level and do not terminate in hubs.
8. End Bell Entrances to Polymer Concrete Handholes: Use end bells, spaced approximately 10 inch o.c. for 5 inch duct, and vary proportionately for other duct sizes.
- a. Begin change from regular spacing to end-bell spacing 10 ft from end bell, without reducing duct slope and without forming trap in line.
 - b. Grout end bells into structure walls from both sides to provide watertight entrances.
9. Building Wall Penetrations: Make transition from underground duct to steel raceway at least 10 ft outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to steel raceway type installed. Install steel raceway penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
10. Install manufactured steel raceway elbows for stub-ups at poles unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
- a. Couple steel elbows to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch of concrete for minimum of 12 inch on each side of coupling.
11. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15 psig hydrostatic pressure.
12. Pulling Cord: Install 200 lbf test nylon cord in empty ducts.
13. Direct-Buried Duct and Duct Bank:
- a. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
 - b. Width: Excavate trench 3 inch wider than duct on each side.
 - c. Depth: Install top of duct at least 36 inch below finished grade unless otherwise indicated.

- d. Set elevation of top of duct bank below frost line.
 - e. Place minimum 3 inch of sand as bed for duct. Place sand to minimum of 6 inch above top level of duct.
 - f. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 - g. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 ft of duct. Place spacers within 24 inch of duct ends. Stagger spacers approximately 6 inch between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - h. Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - i. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inch over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
14. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inch above concrete-encased duct and duct banks and approximately 12 inch below grade. Align tape parallel to and within 3 inch of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inch. Space additional tapes 12 inch apart, horizontally across width of ducts.
 15. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Interfaces with Other Work:

1. Coordinate installation of electrical duct bank with new utility services to building and existing conditions

3.6 INSTALLATION OF HANDHOLES AND BOXES

A. Reference Standards:

1. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
4. Install handholes and boxes with bottom below frost line, 42-inches below grade.
5. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
7. For enclosures installed in asphalt paving and concrete and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour concrete ring encircling, and in contact with enclosure entry, and with top surface screeded to top of box cover frame. Bottom of ring must rest on compacted earth.
 - a. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with troweled finish.
 - b. Dimensions: 10 inch wide by 12 inch deep.
8. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Nonconforming Work:

1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
2. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.8 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.
 - 1. Sweep floor, removing dirt and debris.
 - 2. Remove foreign material.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.5 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
- C. Tape Properties:
 - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
 - 2. Overall Thickness: 5 mils.
 - 3. Foil Core Thickness: 0.35 mil.
 - 4. Weight: 28 lb/1000 sq. ft..
 - 5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.10 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.

- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0 or better.
 - 4. UL 62275: Type 21S.
 - 5. Temperature Range: Minus 50 to plus 284 deg F.
 - 6. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

- I. Cable Ties: For attaching tags. Use as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
 - 3. General purpose: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 30-foot maximum intervals.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 240/120V or 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue. (Omit on 240/120V systems)
 - 4) Neutral: White.
 - 5) Ground: Green.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral: Gray.
 - 5) Ground: Green.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

- C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes self-adhesive, self-laminating polyester labels with the conductor designation.
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- I. 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.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:

- a. Indoor Equipment: Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment to Be Labeled:
- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Enclosed switches.
 - f. Enclosed circuit breakers.
 - g. Enclosed controllers.
 - h. Variable-speed controllers.
 - i. Push-button stations.
 - j. Contactors.
 - k. Remote-controlled switches, dimmer modules, and control devices.
 - l. Monitoring and control equipment.
 - m. UPS equipment.

END OF SECTION 260553

SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.
- E. SCCR: Short-circuit current rating.
- F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- G. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies.

B. Study Submittals:

1. Submit the following after approval of system protective devices submittals. Submittals must be in digital form:
 - a. Arc-flash study input data, including completed computer program input data sheets.

- b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
- c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 QUALITY ASSURANCE

- A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms must comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. EDSA Micro Corporation.
 - 2. EasyPower, LLC (formerly ESA Inc.).
 - 3. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer program must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.
- E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- F. Arc-Flash Study Output Reports:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.
- G. Incident Energy and Flash Protection Boundary Calculations:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.
 - 7. Working distance.
 - 8. Incident energy.
 - 9. Hazard risk category.
 - 10. Recommendations for arc-flash energy reduction.

- H. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce **3.5 by 5 inch (76 by 127 mm)** self-adhesive equipment label for each work location included in analysis.
- B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 - 4. Arc flash PPE category.
 - 5. Required minimum arc rating of PPE in Cal/cm squared.
 - 6. Available incident energy.
 - 7. Working distance.
 - 8. Engineering report number, revision number, and issue date.
- C. Labels must be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform Short-Circuit study prior to starting Arc-Flash Hazard Analysis or obtain results from another source.
- C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current in accordance with IEEE 1584 recommendations.
 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
 4. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.
- D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 30 kVA.
- F. Calculate limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:
1. Fault contribution from induction motors must not be considered beyond three to five cycles.
 2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).
- H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:
1. When circuit breaker is in separate enclosure.
 2. When line terminals of circuit breaker are separate from work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

- A. Obtain data necessary for conduct of arc-flash hazard analysis.
1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to amount of detail that is required to be

acquired in field. Field data gathering must be under direct supervision and control of engineer in charge of performing study, and must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance or available short circuit current at service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
11. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
12. Motor horsepower and NEMA MG 1 code letter designation.
13. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.4 LABELING

- A. Apply one arc-flash label on front cover of each section of equipment for each equipment included in study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below must have arc-flash label applied to it:
 1. Switchboards.
 2. Panelboards.
 3. Low voltage transformers.
 4. Safety switches.
- C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.
 1. Indicate arc-flash energy.
 2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573.19

SECTION 260923 – AUTOMATIC LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Daylight-Harvesting Dimming Controls.
 - 2. Low Voltage Occupancy & Vacancy Sensor Systems.
 - 3. Wall-box Mounted Occupancy Sensor Switches.
 - 4. Wall-box Mounted Vacancy Sensor Switches.
 - 5. Lighting Contactors.
- B. Related Requirements:
 - 1. Section 262726 "Wiring Devices" for manual toggle switches and dimmers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Provide specific model numbers & options.
 - 1. Product specifications including: Electrical ratings, power consumption, rated operating environment, dimensions, features, operation, listings and ratings, and warranty length.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 - c. Faulty operation of lighting control equipment.
 2. Warranty Period: five (5) year(s) from date of Substantial Completion.

2.2 DAYLIGHT-HARVESTING DIMMING CONTROLS

- A. **Products:** Subject to compliance with requirements, provide one of the following:
1. [Eaton / Cooper Industries, Inc / Greengate.](#)
 2. [Hubbell Building Automation, Inc.](#)
 3. [Leviton Manufacturing Co., Inc.](#)
 4. [Watt Stopper / Legrande.](#)
- B. **System Description:** Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. **Ceiling-Mounted Dimming Controls:** Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.
- D. **Electrical Components, Devices, and Accessories:**
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. **Sensor Output:** sends digital signal compatible with Power Pack (Room Controller), 0- to 10-V dc signal to operate luminaires created by Power Pack (Room Controller). Sensor is powered by controller unit.

3. Light-Level Sensor Set-Point Adjustment Range: 1 to 100 fc.
4. Sensor Output: Digital signal compatible with Power Pack (Room Controller) utilizing Cat 5e cable or better.
5. Power Pack: Digital controller capable of accepting (3) RJ45 inputs with up to three (per switching shown on drawings) switching outputs rated for 20-A ballast or LED load at 120- and 277-V ac, and for 1 hp at 120- and 277-V ac. Power Pack has 24-V dc, 150-mA minimum, Class 2 power source, as defined by NFPA 70.
 - a. LED status lights to indicate load status.
 - b. Plenum rated.
 - c. With integral current monitoring.
 - d. Compatible with digital addressable lighting interface
6. Daylight Harvesting device (sensor with 'DH'): Light-level monitoring range: 1 to 200 fc. Powered by Power Pack.
 - a. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
 - b. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.
 - c. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.
7. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
8. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
9. Test Mode: User selectable, overriding programmed time delay to allow settings check.
10. Control Load Status: User selectable to confirm that load wiring is correct.
11. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.3 LOW VOLTAGE OCCUPANCY & VACANCY SENSOR SYSTEMS

A. Products: Subject to compliance with requirements, provide one of the following:

1. [Bryant Electric.](#)
2. [Eaton / Cooper Industries, Inc / Greengate.](#)
3. [Hubbell Building Automation, Inc.](#)
4. [Leviton Manufacturing Co., Inc.](#)
5. [Philips Electronics North America Corporation.](#)
6. [Lutron Electronics Co., Inc.](#)
7. [Schneider Electric / Square D.](#)
8. [Watt Stopper / Legrande.](#)

B. General Requirements for Sensors: Wall- or ceiling-mounted as shown, solid-state indoor occupancy or vacancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated:

- a. Occupancy Sensor Systems: system turns lights 'on' when coverage area is occupied, and turns lights 'off' when unoccupied; with a time delay for turning lights 'off', adjustable over a minimum range of 1 to 30 minutes; Default setting 15 minutes.
 - b. Vacancy Sensor Systems: lights turned 'on' manually thru a switch, and system turns lights 'off' when space is vacant; with a time delay for turning lights 'off', adjustable over a minimum range of 1 to 30 minutes; Default setting 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, and for 1 hp at 120- and 277-V ac. Power Pack has 24-V dc, 150-mA minimum, Class 2 power source, as defined by NFPA 70.
 5. Provide associated control buttons compatible with powerpack/room controller to provide functionality as shown on drawings.
 6. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 7. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 8. Bypass Switch: Override the 'on' function in case of sensor failure.
 9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. Ceiling mounted, Dual Technology, wide view
1. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 2. Sensitivity Adjustment: Separate for each sensing technology.
 3. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 4. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 5. Basis of Design: Wattstopper – DT-305 Series
 - 6.
- D. Ceiling mounted, Ultrasonic Technology, long range narrow view
1. Ultrasonic Technology Type: Ceiling mounted; detect occupants in coverage area using ultrasonic detection methods.
 2. Sensitivity Adjustment.
 3. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average

- size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
4. Detection Coverage (Corridors): Detect occupancy anywhere within a rectangular area of 10ft x 90ft when mounted on a 96-inch- high ceiling.
 5. Basis of Design: Wattstopper – W-2000H Series

2.4 WALL-BOX MOUNTED OCCUPANCY SENSOR SWITCHES

A. Products: Subject to compliance with requirements, provide one of the following:

1. Bryant Electric.
2. Eaton / Cooper Industries, Inc / Greengate.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Philips Electronics North America Corporation.
6. Lutron Electronics Co., Inc.
7. Schneider Electric / Square D.
8. Watt Stopper / Legrande.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang wall-box.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
4. Sensor Operation: automatic-on operation, and automatic-off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Field-select an off time of 10 minutes, unless noted otherwise or directed otherwise by owner.
5. 3-Way operation where shown on drawings.
6. 0-10V dimming where shown on drawings.
7. Tested utilizing NEMA WD 7 Standard.
8. Neutral required. In retrofit applications, extend neutral of lighting circuit into wall-box for connection.
9. Color: Match color specified in Section 26 2726 Wiring Devices.
10. Faceplate: Color matched to switch.

C. Wall-Switch Sensor Tag ‘O’:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: Single or Double Pole as shown on drawings, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage.

5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.5 WALL-BOX MOUNTED VACANCY SENSOR SWITCHES

A. Products: Subject to compliance with requirements, provide one of the following:

1. Bryant Electric.
2. Eaton / Cooper Industries, Inc / Greengate.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Philips Electronics North America Corporation.
6. Lutron Electronics Co., Inc.
7. Schneider Electric / Square D.
8. Watt Stopper / Legrande.

B. General Requirements for Sensors: wall-switch vacancy sensor, suitable for mounting in a single gang wall-box.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED at 277 V, and 800-W incandescent.
4. Sensor Operation: manual-on operation, and automatic-off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Field-select an off time of 10 minutes, unless noted otherwise or directed otherwise by owner.
5. 3-Way operation where shown on drawings.
6. 0-10V dimming where shown on drawings.
7. Tested utilizing NEMA WD 7 Standard.
8. Neutral required. In retrofit applications, extend neutral of lighting circuit into wall-box for connection.
9. Color: Match color specified in Section 26 2726 Wiring Devices.
10. Faceplate: Color matched to switch.

C. Wall-Switch Sensor Tag 'V':

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: Single or Double Pole as shown on drawings.
4. Voltage: Match the circuit voltage.
5. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.6 LIGHTING CONTACTORS

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies, LP; a business of Emerson Network Power.
 3. Eaton Corporation.
 4. General Electric Company.
 5. Schneider Electric / Square D.
- B. Description: Electrically operated and electrically held, combination-type lighting contactors, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
- C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.
1. Control: On-off operation, time of day operation.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Control Power Sources: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables".
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than 22 AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Conductors and Cables".
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than 16 AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Conductors and Cables".
- D. Sensor Control Cabling: Class 2 or 3 Control Cable or Plenum rated Cat 5e or better cable, as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL REQUIREMENTS

- A. Comply with NECA 1.
- B. Neutral required for all lighting control devices that require power. In retrofit applications, extend neutral of that lighting branch circuit to device. Shunting any amount of current to ground is not permitted, without written authorization from engineer.

3.3 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.4 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.5 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.6 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system. This service is typically provided at an additional cost but shall be included.
- B. The electrical contractor shall provide both the manufacturer and the Architect/Construction Manager with ten working days written notice of the scheduled commissioning date. Upon completion of the system fine tuning the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors.

3.9 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Electronic-grade panelboards.
 - 4. Disconnecting and Overcurrent Protective Devices.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. MCCB: Molded-case circuit breaker.
- E. SPD: Surge protective device.
- F. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.

2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 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. Keys: Two spares for each type of panelboard cabinet lock.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.9 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 1 years from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.

- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets as shown on drawings. NEMA 250, type as shown on drawings.
 - 1. Height: 84 inches maximum.
 - 2. Panelboard front cover:
 - a. Front cover general requirements: For surface-mounted panelboards, fronts cover shall match box dimensions. For flush-mounted panelboards, front cover shall overlap box.
 - 3. Finishes:
 - a. Panels and Trim: Other than NEMA 4/4X: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. NEMA 4/4X: material as called for on drawing.
 - b. Back Boxes: NEMA 1: Galvanized steel. Other than NEMA 1: Same finish as panels and trim.
- F. Incoming Mains:
 - 1. Location: Convertible between top and bottom.
 - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
 - 3. Vertically mounted main circuit breaker.
- G. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
 - 5. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device, on load side of main device.
 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: 25 percent.
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 and Type 2.

2.3 DISTRIBUTION PANELBOARDS

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Eaton Electrical Sector; Eaton Corporation.
 2. General Electric Company; GE Energy Management - Electrical Distribution.
 3. Siemens Energy.
 4. Square D; by Schneider Electric.

- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As scheduled on drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers or Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. Siemens Energy.
 - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As scheduled on drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Piano Hinged Front Cover: Entire front trim with piano hinge to backbox and retained with screws, with standard door with lock within hinged trim cover. Trim shall cover all live parts. No EZ trim with set screw blocking circuit breakers will be allowed. No lift and shift trim allowed.

2.5 ELECTRONIC-GRADE PANELBOARDS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. Siemens Energy.
 - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.

- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. Piano Hinged Front Cover: Entire front trim with piano hinge to backbox and retained with screws, with standard door with lock within hinged trim cover. Trim shall cover all live parts. No EZ trim with set screw blocking circuit breakers will be allowed. No lift and shift trim allowed.
- G. SPD:
 - 1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
 - 2. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - a. Line to Neutral: 700 V for 208Y/120 V.
 - b. Line to Ground: 700 V for 208Y/120 V.
 - c. Neutral to Ground: 700 V for 208Y/120 V.
 - d. Line to Line: 1200 V for 208Y/120 V.
 - 3. SCCR: Equal to the SCCR of the panelboard in which installed.
 - 4. Inominal Rating: 20 kA.
- H. Buses:
 - 1. Copper phase and neutral buses; 200% percent capacity neutral bus and lugs.
 - 2. Copper equipment ground buses.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. Siemens Energy.
 - 4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - h. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.7 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.

- C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- D. Equipment Mounting:
 - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.
- J. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces or vacated spaces. Bus bars shall not be exposed through any gaps or holes in the panelboard face.
- N. Stub four 1-1/2-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-1/2-inch empty conduits into raised floor space or below slab not on grade.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- P. Turn all 'spare' breaker to the 'off' position.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. 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 for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each 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:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as directed by Engineer.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 - 1. Measure loads during period of normal facility operations.
 - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262719 - MULTI-OUTLET ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Floor-mounted, enclosure multi-outlet assemblies.
- B. Related Requirements:
 - 1. Section 260533 "Conduits for Electrical Systems"
 - 2. Section 260533 "Boxes and Covers for Electrical Systems" for floor boxes and covers.
 - 3. Section 262726 "Wiring Devices" for receptacles and switches.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Floor-mounted, enclosure multi-outlet assemblies.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED ENCLOSURE MULTI-OUTLET ASSEMBLIES

- A. Description: Floor-mounted box with cover enclosing multiple power and communications outlets in a single assembly.
- B. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
- C. General Characteristics:
 - 1. Reference Standards: UL 514A for metallic boxes; UL 514C for nonmetallic boxes, including scrub-water exclusion requirements; and UL 514D for cover plates.
 - 2. Provide separate paths for management of telecommunications and power cables in accordance with NFPA 76.
 - 3. Compartments: Barrier separates power from voice and data communication cabling.
- D. Source Limitations: Obtain products from single manufacturer designed for use as complete, matching assembly of raceways and receptacles.
- E. Floor-Mounted Enclosure Multi-Outlet Assembly -MSB1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 - c. Wiremold; Legrand North America, LLC.

2. Options:
 - a. Floor Box and Cover:
 - 1) Provide floor boxes classified for use in 2-hour-rated concrete floors. Boxes for floors in contact with earth must be protected with an epoxy paint.
 - 2) Floor boxes for concrete floors must provide a minimum of **4 inch (100 mm)** of adjustment prior to concrete pour and a minimum of **1/2 inch (12.5 mm)** after concrete is set.
 - 3) Provide nonmetallic floor boxes with four gangs.
 - 4) Provide brass or aluminum flanges approved for use on carpet, tile, or wood floor applications. Flanges and cover plates must have a buffed appearance and a protective finish. Covers must match appearance of floor flanges and provide access to included devices.
 - 5) Covers must lay flat on floor surface when open. Provide for cable egress when cover is closed. Provide ADA-compliant covers.
 - 6) Provide flanges, mounting brackets, keystones, and accessories for mounting devices and connections indicated on Drawings.

 - b. Outlets:
 - 1) Power Outlets: two NEMA 5-20R duplex receptacles in accordance with Section 262726 "Wiring Devices."
 - 2) Wiring: Single circuit in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 3) Voice and Data Communication Outlets: four blank inserts with bushed cable opening for cable to be installed by owner.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1 for device mounting heights, except where requirements on Drawings or in this Section are stricter.

- B. Comply with NECA 101 for installation requirements for steel raceways, except where requirements on Drawings or in this Section are stricter.

- C. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies.

- D. Provide terminations, adapters, boxes, and other fittings required for installation.
- E. Do not install PVC raceways where ambient temperature exceeds 122 deg F (50 deg C). Conductors with insulation rated higher than 75 deg C installed in PVC raceways may not be operated at a temperature greater than 75 deg C.
- F. Comply with Section 260526 "Grounding and Bonding for Electrical Systems."
- G. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and support.
- H. Comply with requirements in Section 260533 "Boxes and Covers for Electrical Systems" for additional requirements for floor boxes.
- I. Coordination with Other Work:
 - 1. Adjust locations of multi-outlet assemblies to suit arrangement of partitions and furnishings. Locate outlets to avoid blocking by supports, furnishings, and other architectural fixtures.
 - 2. Provide outlets with special requirements, such as GFCI, AFCI, or special environmental requirements, where required by Drawings or to meet codes.
 - 3. Adjust locations of floor assembly penetrations to coordinate with locations of structural members, concealed piping, and concealed conduit. Obtain written approval from Architect prior to drilling penetrations in floors other than where dimensioned on architectural Drawings. Comply with requirements in Section 078413 "Penetration Firestopping."

3.2 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."

END OF SECTION 262719

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Tamper resistant standard-grade receptacles
 - 2. Tamper resistant GFCI receptacles
 - 3. Twist-locking receptacles.
 - 4. Toggle switches,
 - 5. Wall/Cover plates.
 - 6. Wall box dimmers.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
 2. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
 3. Leviton Manufacturing Co., Inc.
 4. Pass & Seymour; Legrand North America, LLC.
- B. Source Limitations: Obtain each type of wiring device and associated coverplate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Where required, simplex receptacles shall be of the same model series with equivalent properties as the duplex receptacle.
- C. Comply with NFPA 70.
- D. RoHS compliant.
- E. Comply with NEMA WD 1.
- F. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 2. Devices shall comply with requirements in this Section.
- G. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
 2. Cord and Plug Sets: Match equipment requirements.
- H. Face Style: Indented face for standard types, smooth face for decorator style types.
- I. Device Color:
1. Wiring Devices Connected to Normal Power System: as selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
- J. Wall Plate Color: For plastic covers, match device color.
- K. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Standards: Comply with UL 498 and FS W-C-596.
 4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 GFCI RECEPTACLES, 125 V, 20 A

- A. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
 2. Configuration: NEMA WD 6, Configuration 5-20R.
 3. Type: Non-feed through.
 4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.5 TWIST-LOCKING RECEPTACLES

- A. Twist-Lock, Single Receptacles, 250 V, 20 A:
1. Configuration: NEMA WD 6, Configuration L6-20R.
 2. Standards: Comply with UL 498.

2.6 SPECIAL PURPOSE DEVICES

- A. Boiler Emergency Shut Down Station – One N.O. and one N.C. switched contact device, rated 3A per contact at 600VAC, and 1A per contact at 250VAC, factory installed on a stainless steel

backplate assembly. Actuator shall be momentary maintained – push to activate, ¼ turn to reset contact mushroom head style, fabricated from polycarbonate material, red in color, regressed back from station cover, with “PUSH” permanently embossed in face, with white filled letters. Station cover shall be fabricated from molded polycarbonate material, yellow in color, with “BOILER SHUT DOWN” permanently embossed in face, with white filled letters.:

1. Safety Technology International, Inc. – STI Series 2000
2. Allen Bradley
3. General Electric
4. Cutler Hammer/Westinghouse
5. Square D
6. Siemens

2.7 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
 1. Standards: Comply with UL 20 and FS W-S-896.
- B. Double-Pole Switches, 120/277 V, 15 A:
 1. Standards: Comply with UL 20 and FS W-S-896.
- C. Three-Way Switches, 120/277 V, 20 A:
 1. Comply with UL 20 and FS W-S-896.

2.8 WALL/COVER PLATES

- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact nylon.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Outdoor/Wet-Location, Receptacle Plates: for receptacles installed outdoors, indoors in wet-locations, or noted with device subscript “WP”; provide:
 1. Non-metallic, weathertight surface coverplate.
 2. UL listed “Suitable for Wet-Locations While-In-Use”.
 3. Padlocking provision
 4. Rated NEMA 3R while in use.
 5. Closed-cell foam gasketing.
 6. Provide size and configuration for intended use of receptacle.
 7. Acceptable Manufacturers:
 - a. Mulberry Metal Products – Series
 - b. Thomas & Betts – Red Dot Code Keeper Non-metallic Series
 - c. Raco/TayMac/Bell – Rayntite II Series

2.9 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Faceplate Color: Match Normal Power System Wiring Device Color as specified in Section 262726 “Wiring Devices”.
 - 1. Faceplate shall be nylon
 - 2. Faceplate shall attached to device with no exposed fasteners.
- C. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- D. LED:
 - 1. 0-10V Linear Slide Type:
 - a. Shall be solid state electronic, electro-mechanical device, with linear slide style actuator, suitable for use, and compatible with the procured 0-10V LED drivers.
 - 1) UP movement of actuator from lowest position turns connected load ON, via a remote, separately installed power supply/control unit with integral switching relay.
 - 2) UP/DOWN linear slide movement of actuator raises/lowers lighting intensity.
 - 3) DOWN movement of actuator to lowest position turns connected load OFF, via a remote, separately installed power supply/control unit with integral switching relay.
 - b. Shall, in combination with the remote power supply/control unit switching relay, be rated to control not less than the following dimmable LED lighting load:
 - 1) 20A @ 120VAC.
 - 2) 20A @ 277VAC.
 - c. Provide as single pole or 3-way multi-location control devices as indicated.
 - d. Shall be semi-flush, thin profile design, with no exposed heat sink fins, designed, fabricated, and tested for installation within a single gang electric box opening.
 - e. Provide complete with separately installed power supply/control unit. Device shall be:
 - 1) A combination device providing 24VDC (100 mA) output from an input of either 120VAC or 277VAC input, to remotely connected dimmer device.
 - 2) Provided with an integral switching duty relay, rated to interrupt not less than 20A @ 120VAC or 277VAC.
 - 3) Enclosed in a high impact, molded, thermoplastic housing, designed for field installation within or to a standard electrical box. Comply with AHJ for installation instructions.
 - f. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Lutron Electronics, Inc. – “Nova-T Star” NTSTV Series Dimmer and PP-120/277H Power Supply/Control Unit.

- 2) Or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

G. Wall Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
- C. Identify each receptacle on a GFI protected breaker. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate with the marking "GFI PROTECTED".
- D. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-fusible switches.
 - 2. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- B. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
1. **Warranty Period:** One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **Source Limitations:** Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. **Product Selection for Restricted Space:** Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 NONFUSIBLE SWITCHES

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. [ABB \(Electrification Products Division\)](#).
 2. [Eaton](#).
 3. [Schneider Electric USA \(Square D\)](#).
 4. [Siemens Industry, Inc., Energy Management Division](#).
- B. **Type HD, Heavy Duty:**
1. **Interior Construction** – Switch blades fully visible in the off position when the enclosure door is open.
 2. **Switch Mechanism** – Quick make, quick break with positive interlock to prevent opening of enclosure door with operating handle is in the ‘ON’ position and to prevent closing of the switch mechanism with the door open. Operating handle shall be an integral part of enclosure base, have provisions for three padlocks in the ‘OFF’ position, and the means to indicate whether the switch is on or off by its position. Vertical operating handles shall be up in the ‘ON’ position.
 3. **Terminal Lugs** – Suitable for quantity of wire to be attached, front removable with terminal shields; mechanical type connection for copper wire.
 4. Single or Double throw as indicated.
 5. Two, Three, or six pole as indicated.

6. 240 or 600-V ac as required.
7. UL 98 and NEMA KS 1, horsepower rated.
8. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Hookstick Handle: Allows use of a hookstick to operate the handle.
4. When indicated on the load side of a variable speed device (VSD) controller, provide not less than one set of Form C (1 NO & 1 NC) auxiliary contacts arranged to break VSD control circuit before the disconnect switch blades break.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

- A. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts.
- B. Operating Mechanism: The circuit-breaker/disconnect switch operating handle shall be externally operable with the operating mechanism being an integral part of the box - not the cover, directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R), or externally operable with the operating mechanism being an integral part of the cover (NEMA 250 Types 7, 9). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- C. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1, gray baked enamel paint electroplated on cleaned, phosphatized steel.
 - 2. Outdoor Locations: NEMA 250, Type 3R, gray baked enamel paint electroplated on cleaned, phosphatized galvanized steel.
 - 3. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, Stainless steel, Type 304.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V

rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.

- e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as directed by Engineer.

END OF SECTION 262816

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Requirements:
 - 1. Section 262416 "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. ABB USA.
 - 2. Eaton Electrical Sector; Eaton Corporation.
 - 3. General Electric Company.
 - 4. Leviton Manufacturing Co., Inc.
 - 5. Liebert; a brand of Emerson Electric Co.
 - 6. Schneider Electric USA, Inc.
 - 7. Siemens Industry, Inc.
 - 8. Square D; by Schneider Electric.
- B. SPDs: Comply with UL 1449, Type 1.
- C. Comply with UL 1283.

- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 208Y/120 V.
 - 2. Line to Ground: 1200 V for 208Y/120 V.
 - 3. Line to Line: 1000 V for 208Y/120 V.
- F. SCCR: Equal or exceed 100 kA.
- G. I nominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. ABB USA.
 - 2. Eaton Electrical Sector; Eaton Corporation.
 - 3. General Electric Company.
 - 4. Leviton Manufacturing Co., Inc.
 - 5. Liebert; a brand of Emerson Electric Co.
 - 6. Schneider Electric USA, Inc.
 - 7. Siemens Industry, Inc.
 - 8. Square D; by Schneider Electric.
- B. SPDs: Comply with UL 1449, Type 2.
 - 1. Include LED indicator lights for power and protection status.
 - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - 3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Comply with UL 1283.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V for 208Y/120 V.
 - 2. Line to Ground: 700 V for 208Y/120 V.
 - 3. Neutral to Ground: 700 V for 208Y/120 V.

4. Line to Line: 1200 V for 208Y/120 V

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260523 "Control-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260523 "Control-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Interior lighting fixtures, light sources/lamps, and drivers/power supply/ballasts.
- 2. Emergency lighting units.
- 3. Exit signs.
- 4. Lighting fixture supports.

- B. Related Sections:

- 1. Section 260923 "Automatic Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays, wall-box dimmers with sensors, and contactors.
- 2. Section 262726 "Wiring Devices" for toggle switches and wall-box dimmers without sensors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire, arranged in order of luminaire designation, include a separate product data sheet, literature, drawings, etc on each of the following:
 - 1. Luminaire – Include:
 - a. A physical description of luminaire including dimensions.

- b. Features.
 - c. Finishes.
 - d. Lensing.
 - e. Optics.
 - f. Accessories.
 - g. Photometric performance including efficacy and optical efficiency.
 - h. Certifications; Provide evidence of Design Lights Consortium, Energy Star, or Consortium for Energy Efficiency qualifying products for the specific model number of luminaire submitted on when called out on luminaire schedule. Provide product listing from qualifying agency.
2. Driver, power supply, or ballast – Include:
 - a. Input voltage.
 - b. Total input power consumption, in watts, including lamp wattage and ballast losses.
 - c. Line current data.
 - d. Total harmonic distortion data.
 - e. Minimum starting temperature.
 - f. Physical dimensions.
 - g. Sound rating
 3. Light Source / Lamp – Include
 - a. Nominal rated power.
 - b. Shape and/or style of lamp.
 - c. Rated life for 3 hour start and 12 hour start.
 - d. Initial lumens.
 - e. Design lumens.
 - f. CRI
 - g. Color temperature
 - h. Physical dimensions.
 4. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom lighting fixtures. 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. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- E. Field quality-control reports.

- F. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Drivers: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Comply with NFPA 70.

1.8 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.

1.9 WARRANTY

- A. Warranties in this Article shall be provided and run concurrent with other warranties required of the Contractor under the requirements of the Contract Documents. Warranty shall begin at time of Substantial Completion of project.
- B. Warranties for LED Drivers: Written warranty, executed by manufacturer, agreeing to replace LED Drivers, including labor, that fail in materials or workmanship within five years.

- C. Warranties for LED Light Source: Written warranty, executed by manufacturer, agreeing to replace LED Light Source, including labor, that fail in materials or workmanship within five years.
- D. Warranties for luminaire finishes: Written warranty, executed by manufacturer, agreeing to replace luminaires, including labor, exhibiting a failure of finish as specified below within five years
 - 1. Protection from Corrosion: Warranty against perforation or erosion of finish.
 - 2. Color Retention: Warranty against fading, staining, and chalking.
- E. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
 - 2. Warranty Period for Self-Powered Exit Sign Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers of products not specifically listed in this section or the Luminaire Schedule, or submitting on the basis of "or equivalent", shall provide the following for review prior to, or along with product submission.
 - 1. Documentation showing a minimum of five years experience in the business of design and manufacture of luminaires or lighting equipment similar to the type and quality of products specified.
 - 2. Product data demonstrating conformance with the design criteria listed in the Luminaire Schedule and this section.
 - 3. Prototype and/or operating sample of the product for evaluation by the Engineer. Prototype and/or sample shall be sufficiently details and operational to allow for fair evaluation and to demonstrate compliance with the design criteria specified. Product data and shop fabrication drawings are not acceptable means of providing prototype/sample requirement.
 - 4. Engineer shall be the sole judge of compliance to the design criteria and specifications.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND ACCESSORIES

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging. Unless

- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness:
 - 1) Pattern 12: 0.125 inch overall thickness
 - 2) Pattern 19: 0.156 inch overall thickness
 - 3) Overlay panel: 0.04 inch overall thickness
 - 4) Other lenses: 0.125 in overall thickness
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
 - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - f. CCT and CRI for all luminaires.

2.3 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored,

relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

- d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
- e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.4 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

- 1. Battery: Sealed, maintenance-free, nickel-cadmium type or Lithium-ion
- 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
- 3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
- 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- 6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- 7. Provide high output for remote head application as called for on the Drawings.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
 - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Remote Mounting of power supplies: Distance between the power supply and fixture shall not exceed that recommended by power supply manufacturer. Verify, with power supply manufacturers, maximum distance between power supply and luminaire.
- D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
 - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- E. 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 grid as support for pendant luminaires. Connect support wires or rods to building structure.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. 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.

3.4 STARTUP SERVICE

- A. Burn-in all luminaires, prior to occupancy by Owner. Replace/repair luminaires that fail.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Engineer and/or Architect.

END OF SECTION 265100

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luminaire-mounted photoelectric relays.
2. Luminaire types.
3. Materials.
4. Finishes.
5. Luminaire support components.

B. Related Requirements:

1. Section 260923 "Automatic Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The

adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

- a. **Manufacturer's Certified Data:** Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 6. Wiring diagrams for power, control, and signal wiring.
 7. Photoelectric relays.
 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. **Shop Drawings:** For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. **Product Schedule:** For luminaires and lamps. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. **Operation and Maintenance Data:** For luminaires and photoelectric relays to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.5 QUALITY ASSURANCE

- A. **Luminaire Photometric Data Testing Laboratory Qualifications:**
1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. **Installer Qualifications:** An authorized representative who is trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.7 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 5 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Bulb shape complying with ANSI C79.1.

- G. CRI of minimum 80. CCT of 4100 K.
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac.
- L. In-line Fusing: none
- M. Lamp Rating: Lamp marked for outdoor use.
- N. Source Limitations:
 - 1. Obtain luminaires from single source from a single manufacturer.
 - 2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 MANUFACTURERS

- A. Manufacturers of products not specifically listed in this section or the Luminaire Schedule, or submitting on the basis of “or equivalent”, shall provide the following for review prior to, or along with product submission.
 - 1. Documentation showing a minimum of five years experience in the business of design and manufacture of luminaires or lighting equipment similar to the type and quality of products specified.
 - 2. Product data demonstrating conformance with the design criteria listed in the Luminaire Schedule and this section.
 - 3. Prototype and/or operating sample of the product for evaluation by the Engineer. Prototype and/or sample shall be sufficiently details and operational to allow for fair evaluation and to demonstrate compliance with the design criteria specified. Product data and shop fabrication drawings are not acceptable means of providing prototype/sample requirement.
 - 4. Engineer shall be the sole judge of compliance to the design criteria and specifications.

2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least **0.125 inch (3.175 mm)** minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: Black.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Conduits for Electrical Systems." In concrete foundations, wrap conduit with **0.010-inch- (0.254-mm-)** thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Photoelectric Control Operation: Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. 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.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265619

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Projected beam smoke detectors.
7. Carbon monoxide detectors.
8. Heat detectors.
9. Fire-alarm notification appliances.
10. Fire-alarm remote annunciators.
11. Fire-alarm addressable interface devices.
12. Digital alarm communicator transmitters (DACTs).

- B. Related Requirements:

1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.
2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

- E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- F. NICET: National Institute for Certification in Engineering Technologies.
- G. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.4 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Annunciator panel details as required by authorities having jurisdiction.
 - 5. Detail assembly and support requirements.
 - 6. Include voltage drop calculations for notification-appliance circuits.
 - 7. Include battery-size calculations.
 - 8. Include input/output matrix.
 - 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 - 10. Include performance parameters and installation details for each detector.
 - 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 12. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.

- a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
 - c. Locate detectors in accordance with manufacturer's written instructions.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Qualification Statements: For Installer.
- C. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Record copy of site-specific software.
 - g. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - h. Manufacturer's required maintenance related to system warranty requirements.

- i. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
 5. Keys and Tools: One extra set for access to locked or tamperproofed components.
 6. Audible and Visual Notification Appliances: One of each type installed.
 7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
 2. Installation must be by personnel certified by NICET as fire-alarm Level III technician.
 3. Obtain certification by NRTL in accordance with NFPA 72.
 4. Licensed or certified by authorities having jurisdiction.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ADDRESSABLE FIRE-ALARM SYSTEM

- A. Description:

1. Noncoded, FM Global-placarded addressable system, with multiplexed signal transmission and voice-and-strobe notification for evacuation.

B. Performance Criteria:

1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2. General Characteristics:

- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices:
 - 1) Manual stations.
 - 2) Heat detectors.
 - 3) Smoke detectors.
 - 4) Duct smoke detectors.
 - 5) Carbon monoxide detectors.
 - 6) Automatic sprinkler system water flow.
- c. Fire-alarm signal must initiate the following actions:
 - 1) Continuously operate alarm notification appliances, including voice evacuation notices.
 - 2) Identify alarm and specific initiating device at FACU and remote annunciators.
 - 3) Transmit alarm signal to remote alarm receiving station.
 - 4) Unlock electric door locks in designated egress paths.
 - 5) Release fire and smoke doors held open by magnetic door holders.
 - 6) Activate voice/alarm communication system.
 - 7) Switch HVAC equipment controls to fire-alarm mode.
 - 8) Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 9) Record events in system memory.
- d. Supervisory signal initiation must be by one or more of the following devices and actions:
 - 1) Valve supervisory switch.
 - 2) High- or low-air-pressure switch of dry-pipe or preaction sprinkler system.
 - 3) Alert and Action signals of air-sampling detector system.
 - 4) Zones or individual devices have been disabled.
 - 5) FACU has lost communication with network.
- e. System trouble signal initiation must be by one or more of the following devices and actions:

- 1) Open circuits, shorts, and grounds in designated circuits.
- 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
- 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
- 4) Loss of primary power at FACU.
- 5) Ground or single break in internal circuits of FACU.
- 6) Abnormal ac voltage at FACU.
- 7) Break in standby battery circuitry.
- 8) Failure of battery charging.
- 9) Abnormal position of switch at FACU or annunciator.
- 10) Voice signal amplifier failure.

f. System Supervisory Signal Actions:

- 1) Initiate notification appliances.
- 2) Identify specific device initiating event at FACU and remote annunciators.
- 3) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
- 4) Transmit system status to building management system.

g. Network Communications:

- 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
- 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.
- 3) Provide integration gateway using BACnet for connection to building automation system.

h. Document Storage Box:

- 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch (216-by-279 mm) manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
- 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
- 3) Color: Red powder-coat epoxy finish.
- 4) Labeling: Permanently screened with 1 inch (25 mm) high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
- 5) Security: Locked with 3/4 inch (19 mm) barrel lock. Provide solid 12 inch (304 mm) stainless steel piano hinge.

2.2 FIRE-ALARM CONTROL UNIT (FACU)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Simplex; brand of Johnson Controls International plc, Building Solutions North America.

2. [Edwards; Carrier Global Corporation.](#)
 3. Gamewell-FCI; Honeywell International, Inc.
 4. [Notifier; Honeywell International, Inc.](#)
- B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- C. Performance Criteria:
1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
 2. General Characteristics:
 - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
 - b. Include real-time clock for time annotation of events on event recorder and printer.
 - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
 - d. FACU must be listed for connection to central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
 - f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
 - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
 - g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, 80 characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
 - h. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1) Pathway Class Designations: NFPA 72, Class B.
 - 2) Pathway Survivability: Level 1.
 - 3) Install no more than 100 addressable devices on each signaling-line circuit.
 - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
 - i. Serial Interfaces:

- 1) One dedicated RS 485 port for central-station operation using point ID DACT.
 - 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - 3) One RS 232 port for PC configuration.
 - 4) One RS 232 port for voice evacuation interface.
- j. Notification-Appliance Circuit:
- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
 - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
 - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- k. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must be connected to fire-alarm system.
- l. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- m. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as special module that is part of FACU.
- n. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
- 1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
 - 2) Programmable tone and message sequence selection.
 - 3) Standard digitally recorded messages for "Evacuation" and "All Clear."
 - 4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
- o. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.
- p. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
- q. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory and DACT must be powered by 24 V(dc) source.
- r. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- s. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.

t. Batteries: Sealed lead calcium.

D. Accessories:

1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.
2. Preaction System Functionality:
 - a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

2.3 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
2. Edwards; Carrier Global Corporation.
3. Gamewell-FCI; Honeywell International, Inc.
4. Notifier; Honeywell International, Inc.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
2. Station Reset: Key- or wrench-operated switch.
3. Able to perform at up to 90 percent relative humidity at 90 deg F (32 deg C).
4. Material: Manual stations made of Lexan polycarbonate.
5. Able to be used in indoor areas.

2.4 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
 - b. Edwards; Carrier Global Corporation.
 - c. Gamewell-FCI; Honeywell International, Inc.
 - d. Notifier; Honeywell International, Inc.

2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 268.
 - b. General Characteristics:
 - 1) Detectors must be two-wire type.
 - 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
 - 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
 - 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
 - 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
 - 9) Color: White.
 - 10) Multiple levels of detection sensitivity for each sensor.
 - 11) Sensitivity levels based on time of day.

2.5 DUCT SMOKE DETECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
 2. Edwards; Carrier Global Corporation.
 3. Gamewell-FCI; Honeywell International, Inc.
 4. Notifier; Honeywell International, Inc.
- B. Description: Photoelectric-type, duct-mounted smoke detector.
- C. Performance Criteria:

1. Regulatory Requirements:
 - a. NFPA 72.
2. General Characteristics:
 - a. Detectors must be two-wire type.
 - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
 - f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
 - g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
 - h. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - i. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 PROJECTED BEAM SMOKE DETECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
 2. Edwards; Carrier Global Corporation.
 3. Gamewell-FCI; Honeywell International, Inc.
 4. Notifier; Honeywell International, Inc.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:

- a. Projected Beam Light Source and Receiver: Designed to accommodate small angular movements and continue to operate and not cause nuisance alarms.
- b. Detector Address: Accessible from FACU and able to identify detector's location within system and its sensitivity setting.
- c. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).

2.7 CARBON MONOXIDE DETECTORS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 1. Gamewell-FCI; Honeywell International, Inc.
 2. **Notifier; Honeywell International, Inc.**
 3. Kidde Fire Systems; Carrier Global Corporation.
 4. Potter Electric Signal Company, LLC.
- B. Description: Carbon monoxide detector listed for connection to fire-alarm system.
- C. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72
 - b. NFPA 720.
 - c. UL 2075.
 2. General Characteristics:
 - a. Mounting: Adapter plate for outlet box mounting.
 - b. Testable by introducing test carbon monoxide into sensing cell.
 - c. Detector must provide alarm contacts and trouble contacts.
 - d. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 - e. Locate, mount, and wire in accordance with manufacturer's written instructions.
 - f. Provide means for addressable connection to fire-alarm system.
 - g. Test button simulates alarm condition.

2.8 HEAT DETECTORS

- A. Combination-Type Heat Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
 - b. Edwards; Carrier Global Corporation.
 - c. Gamewell-FCI; Honeywell International, Inc.
 - d. Notifier; Honeywell International, Inc.

 2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 521.

 - b. General Characteristics:
 - 1) Temperature sensors must test for and communicate sensitivity range of device.

 - c. Actuated by fixed temperature of **135 deg F (57 deg C)** or rate of rise that exceeds **15 deg F (8 deg C)** per minute unless otherwise indicated.
 - d. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
 - f. Detector must have functional humidity range of 10 to 90 percent relative humidity.
 - g. Color: White.
- B. Fixed-Temperature-Type Heat Detectors:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
 - b. Edwards; Carrier Global Corporation.
 - c. Gamewell-FCI; Honeywell International, Inc.
 - d. Notifier; Honeywell International, Inc.

 2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 521.

 - b. General Characteristics:

- 1) Actuated by temperature that exceeds fixed temperature of 190 deg F (88 deg C).
- 2) Mounting: Adapter plate for outlet box mounting.
- 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 4) Detector must have functional humidity range of 10 to 90 percent.
- 5) Color: White.

2.9 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Voice/Tone Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
 - b. Edwards; Carrier Global Corporation.
 - c. Gamewell-FCI; Honeywell International, Inc.
 - d. Notifier; Honeywell International, Inc.
2. Description: Notification appliances capable of outputting voice evacuation messages.
3. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 1480.
 - b. General Characteristics:
 - 1) Speakers for Voice Notification: Locate speakers for voice notification to provide intelligibility requirements of "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
 - 2) High-Range Units: Rated 2 to 15 W.
 - 3) Low-Range Units: Rated 1 to 2 W.
 - 4) Mounting: semi-recessed or surface mounted and bidirectional.
 - 5) Matching Transformers: Tap range matched to acoustical environment of speaker location.
 - 6) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. [Simplex; brand of Johnson Controls International plc, Building Solutions North America.](#)
 - b. [Edwards; Carrier Global Corporation.](#)
 - c. Gamewell-FCI; Honeywell International, Inc.
 - d. [Notifier; Honeywell International, Inc.](#)
2. Performance Criteria:
- a. Regulatory Requirements:
 - 1) NFPA 72.
 - 2) UL 1971.
 - b. General Characteristics:
 - 1) Rated Light Output:
 - a) 15/30/75/110 cd, selectable in field.
 - 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
 - 3) Mounting: Wall mounted unless otherwise indicated.
 - 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
 - 5) Flashing must be in temporal pattern, synchronized with other units.
 - 6) Strobe Leads: Factory connected to screw terminals.
 - 7) Mounting Faceplate: Factory finished, red.

2.10 FIRE-ALARM REMOTE ANNUNCIATORS

- A. [Manufacturers:](#) Subject to compliance with requirements, provide products by the following:
1. [Simplex; brand of Johnson Controls International plc, Building Solutions North America.](#)
 2. [Edwards; Carrier Global Corporation.](#)
 3. Gamewell-FCI; Honeywell International, Inc.
 4. [Notifier; Honeywell International, Inc.](#)
- B. Performance Criteria:
1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:
 - a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
 - 1) Mounting: Flush cabinet, NEMA 250, Type 1.

- b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

- A. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
 1. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
 2. Edwards; Carrier Global Corporation.
 3. Gamewell-FCI; Honeywell International, Inc.
 4. Notifier; Honeywell International, Inc.
- B. Performance Criteria:
 1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:
 - a. Include address-setting means on module.
 - b. Store internal identifying code for control panel use to identify module type.
 - c. Listed for controlling HVAC fan motor controllers.
 - d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
 - 1) Allow control panel to switch relay contacts on command.
 - 2) Have minimum of two normally open and two normally closed contacts available for field wiring.
 - e. Control Module:
 - 1) Operate notification devices.
 - 2) Operate solenoids for use in sprinkler service.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 1. Bosch Security Systems, Inc.
 2. Edwards; Carrier Global Corporation.
 3. Gamewell-FCI; Honeywell International, Inc.
 4. Potter Electric Signal Company, LLC.
- B. Performance Criteria:
 1. Regulatory Requirements:

- a. NFPA 72.
2. General Characteristics:
 - a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
 - b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.
 - c. Local functions and display at DACT must include the following:
 - 1) Verification that both telephone lines are available.
 - 2) Programming device.
 - 3) LED display.
 - 4) Manual test report function and manual transmission clear indication.
 - 5) Communications failure with central station or FACU.
 - d. Digital data transmission must include the following:
 - 1) Address of alarm-initiating device.
 - 2) Address of supervisory signal.
 - 3) Address of trouble-initiating device.
 - 4) Loss of ac supply.
 - 5) Loss of power.
 - 6) Low battery.
 - 7) Abnormal test signal.
 - 8) Communication bus failure.
 - e. Secondary Power: Integral rechargeable battery and automatic charger.
 - f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.
- B. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before other trades have completed cleanup must be replaced.
 - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than **78 inch (1980 mm)** above finished floor.
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in normal path of egress within **60 inch (1520 mm)** of exit doorway.
 - 2. Mount manual fire-alarm box on background of contrasting color.
 - 3. Operable part of manual fire-alarm box must be between **42 and 48 inch (1060 and 1220 mm)** above floor level. Devices must be mounted at same height unless otherwise indicated.
- D. Smoke- and Heat-Detector Spacing:
 - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing must not exceed **30 ft. (9 m)**.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A or Annex B in NFPA 72.
 - 5. HVAC: Locate detectors not closer than **36 inch (910 mm)** from air-supply diffuser or return-air opening.

6. Lighting Fixtures: Locate detectors not closer than **12 inch (300 mm)** from lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than **36 inch (9100 mm)** long must be supported at both ends.
 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- G. Audible Alarm-Indicating Devices: Install not less than **6 inch (150 mm)** below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least **6 inch (150 mm)** below ceiling. Install devices at same height unless otherwise indicated.
- I. Device Location-Indicating Lights: Locate in public space near device they monitor.

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 must be laminated acrylic or melamine plastic signs with red 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."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

- A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.
- B. Pathways must be installed in EMT.
- C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than **36 inch (910 mm)** from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
 - 2. Smoke dampers in air ducts of designated HVAC duct systems.
 - 3. Magnetically held-open doors.
 - 4. Electronically locked doors and access gates.
 - 5. Supervisory connections at valve supervisory switches.
 - 6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 7. Data communication circuits for connection to building management system.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in location visible from FACU.

3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

- A. Administrant for Tests and Inspections:
 - 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
 - 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
 - 4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
 - 5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
 - 6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Allow Owner to record training.

3.12 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. It is the intent of this section to limit the area of clearing and grubbing to the minimum area possible to allow for the proper installation of the work and to preserve all plantings, trees, shrubs, grass, and natural vegetation to the maximum extent possible.
2. Provide stripping and stockpiling of topsoil.
3. Provide clearing and grubbing of all trees, plants, undergrowth, shrubs, brush, other vegetation and debris within the limits indicated on the Contract Drawings and as required to complete the work.
4. Protect existing trees and plants scheduled to remain.
5. Remove all fence, sidewalk, granite curb, concrete curb, asphalt pavement, concrete pavement, utility structures, pipes, conduits, site lighting, utility poles and other items as indicated on the Contract Drawings or as needed to complete the work.
6. Remove all site amenities as designated on the Drawings or as needed to complete the work including but not limited to: signs, guide rails, etc.
7. Disconnect, cap or seal, and remove and/or abandon site utilities in place. Provide bypassing of flows as needed to complete and protect the work.
8. Properly dispose of all removed materials not designated to be reused or delivered to the Owner.
9. Fill and properly compact voids left from clearing and grubbing and buried utility removal activities with backfill materials to meet the finished treatments. (Refer to Part 3 "Clearing and Grubbing")
10. Building and foundation demolition are covered under other specification sections.

B. Related Sections:

1. Division 31 Section **“Earth Moving”**
2. Division 31 Section **“Erosion and Sediment Control”**
3. Division 32 Section **“Maintenance and Protection of Traffic”**

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, materials toxic to plant growth, or other nonsoil materials. These soils typically need to be screened and amended before satisfying the requirements of topsoil for landscaping purposes.
- D. Plant-Protection Zone: Area surrounding planting beds, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- F. Caliper: Diameter of a trunk measured by a diameter tape at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Submit name and qualifications of certified Arborist and tree service firm to be utilized.

- B. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- C. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- D. Existing Conditions: Documentation of existing trees and plantings, indicated to remain and adjoining construction and/or site improvements which establishes preconstruction conditions that might be misconstrued as damage caused by site clearing or other construction related activities.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- E. Label or pruning paint data proposed for use.
- F. Antirust coating data proposed for use.
- G. Contractor's schedule indicating dates upon which Contractor and Owner's Designated Representative will traverse the site to allow Contractor to indicate the trees and plantings which he has determined to be necessary to remove, trimmed, or replanted and to obtain Owner's Designated Representative's approval.
- H. Detailed plan on handling of bypass flows during construction including equipment and methods proposed, timeline, crews and contingency plan. This plan will be reviewed by the Architect/Engineer and no bypass operations will be permitted without an approved plan.
- I. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this project and that will assign an experienced, qualified arborist to project site during execution of the work.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Field quality control.

- D. Confine clearing and grubbing operations to within the limits shown on the Contract Drawings or as otherwise designated by the Architect/Engineer. General limits include:
1. All areas where work is required to be done, but, to the minimum extent possible to properly install the work.
 2. Within the grading limits shown on the Drawings.
 3. Within existing public rights-of-way or easement.
 4. Within contract limits.
- E. No trees, plants, shrubs, flowers or vegetation shall be removed or trimmed without prior permission of the Architect/Engineer or Owner's Designated Representative, except where otherwise specified or directed.
- F. Pruning of trees shall be completed by a trained arborist.
- G. Provide at least one person who shall be present at all times during clearing and grubbing operations who shall be thoroughly familiar with the following:
1. The types of trees and plantings encountered.
 2. The proper procedures and methods for preserving trees.
 3. The proper procedures and methods for felling, trimming, pruning, and caring for trees and plants and their roots.
- Such person(s), firm(s), or subcontractor(s) must be totally familiar with this type of work, must be regularly engaged in similar work and shall be responsible for directing all work affecting trees, plantings, and vegetation.
- H. Comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess and waste materials.
- I. Erosion control measures in accordance with Division 31 Section "Erosion and Sediment Control", the Project SWPPP, and the NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-15-002) shall be followed.
- J. Obtain and pay for all required inspections, permits, and fees. Provide notices required by governmental authorities.

1.7 PROJECT CONDITIONS

- A. Burning or burial of materials at the site is not permitted.
- B. Explosives are not permitted for clearing and grubbing operations.
- C. Minimize interference with adjoining roads, streets, walks, parking areas and other adjacent occupied or used facilities during site-clearing operations. Refer to Division 32 Section "Maintenance and Protection of Traffic" for traffic maintenance information.
- D. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property, if any will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Owner's Designated Representative.
- E. No grubbing shall be allowed along the side slopes of the embankments.
- F. All clearing and grubbing within 5-feet of the embankments shall be performed by pulling debris, sediment or any other materials away from the embankment slope to help protect the downhill areas. No materials within this area shall be pushed down the embankment slope.
- G. Notify Dig Safely New York (UFPO) prior to commencing any excavation. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Provide adequate means of protection of utilities and services, which are not designated to be removed. Repair utilities damaged during site work operations at Contractor's expense.
- H. The Project Site Owner is not a member of Dig Safely New York. The Contractor alone shall be responsible to locate all utilities and services outside the public rights-of-way. The Contractor shall complete test pits as needed to confirm underground utilities and services. The cost of all test pits shall be included in the price bid. Provide adequate means of protection of utilities and services, which are not designated to be removed. Repair utilities damaged during site work operations at Contractor's expense.
- I. Arrange for disconnection, disconnect, and seal or cap all utilities and services designated to be removed before start of site work operations. Perform all work in accordance with the requirements of the applicable utility company or agency involved. The Contractor shall pay all costs for all utility related work including coordination with and charges from the utility company for work they may require in order to accomplish the work shown or implied.
- J. Should uncharted or incorrectly charted underground piping or other utilities and services be encountered during site work operations, notify the applicable utility company or utility owner immediately to obtain utility company/owner in maintaining active services in operation. The Contractor shall bear the cost of any and all repair work.
- K. Locate, protect, and maintain benchmarks, monuments, control points, and project engineering reference points. Reestablish disturbed or destroyed items at Contractor's expense.
- L. The control of dust, noise, erosion, and sediment originating from construction operations is considered a critical responsibility of the Contractor. The Owner's Designated Representative will be the final judge of the adequacy of the Contractor's dust, noise, erosion, and sedimentation control. Work may be suspended by the Owner's Designated Representative until adequate dust, noise, erosion, and sedimentation control is attained.
- M. Protect existing buildings, paving, and other services or facilities on site and adjacent to the site from damage caused by site work operations. Cost of repair and restoration of damaged items at Contractor's expense.
- N. The location and size of trees, plantings, vegetation, as well as location, size and material of construction of drives, sidewalks, curbs, fences, existing utilities and other living and non-living items, as shown on the Drawings, have been determined by actual surveys at the time surveys were made. Since that time, additional items may have been built, modified, improved or planted, some items may have been removed or replaced, and the condition of things may have changed.

- O. Carefully examine the site prior to bidding and become fully acquainted with the existing conditions as the contract price includes the cost for removing and replacing all obstacles and obstructions, as required, whether shown on the Drawings or not. The contract cost shall also include restoration of all disturbed or damaged areas with in-kind materials at the time of construction, whether shown on the Contract Drawings or not, unless otherwise indicated in the Contract Documents.
- P. Protect and maintain streetlights, parking and sidewalk lighting, emergency phones, utility poles and services, curb boxes, valves, utility structure/piping castings, and other services, except items designated for removal.
- Q. The Contractor shall take precautions to protect from harm the work of other contractors on site, existing facilities, as well as adjacent property. The Contractor shall be responsible for all damage or injury done to pipes, structures, pavement, site amenities, utility features, property or person as a result of work performed to complete this contract. The Contractor at his own expense shall repair or replace such property or item to the satisfaction of the property owner, utility owner, public agency having jurisdiction and/or Architect/Engineer and Owner's Designated Representative.
- R. When it is necessary to haul materials over public or private streets, roads, drives, parking areas, walkways or other pavements, the Contractor shall provide suitable tight vehicles so as to prevent deposits on these pavements. In all cases, where any materials are dropped from the vehicles, the Contractor shall clean up the same as often as directed and keep the crosswalks, streets, roads, drives, parking areas, walkways, and drainage ways (e.g. swales, ditches, gutters, catch basins, manholes, piping, etc.) clean and free from dirt, mud, stone, and other hauled materials.
- S. Responsibility for cleaning private and public; roads, drives, parking areas or walkways, of any material carried onto these roads or other pavements by trucks or other equipment, completing work in support of this project, shall be the Contractor's and cost shall be included in price bid.
- T. The following practices are prohibited within tree- and plant-protection zones:
1. Storage or stockpiling of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging, unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
 8. Do not direct vehicle or equipment exhaust towards protection zones.
 9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
 10. Do not store materials potentially harmful to tree roots. Potentially harmful materials include, but are not limited to: petroleum products; cement; lime; paints; detergents; acids; and, cleaning agents.
- U. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

1.8 STORAGE AND HANDLING

- A. Stockpiling of earth spoil or excess earth material on the site or storage of excavated materials for reuse shall be done in a manner which will not hinder the progress of the work; cause any nuisance; or cause spillage or tracking of materials from the transporting vehicle onto public or private roadways and pavements, or cause an inconvenience to adjacent property owners or the active campus facility.
- B. Obstruction of roads, driveways, parking areas, sidewalks, or interference with drainage along curbs, ditches, or drainage channels with stored material is not permitted.
- C. Store fences, signs, granite curb and other items at approved locations for subsequent reinstallation.
- D. Promptly remove materials not specified to be stored or reused.

1.9 SCHEDULING

- A. Avoid interference with the use of, and passage to and from, adjacent properties, buildings, facilities, driveways, walks, drainage systems, and roads etc.
- B. Do not commence site clearing operations until temporary erosion- and sedimentation-control and tree- and plant-protection measures are in place.
- C. Pavements which are required to be removed, including streets, roadways, driveways, parking areas, and walkways, may be saw cut in advance, but do not remove until the work is ready to be installed.
- D. Do not remove signs, guide rails, and all other control, safety and warning devices until just prior to the installation of the work.
- E. Do not remove fences until the property owners affected are notified at least four days in advance of such removal. Unless written permission from a fence owner is received, do not remove a fence more than 48 hours in advance of the installation of the work affecting the fence.
- F. It is the intent of this section that all items affecting traffic, safety, lives, and the containment of humans and animals and all items essential to the protection of property or the operation of a business be left in place as long as possible and replaced as soon as possible when such items must be removed.

1.10 PROTECTION AND COORDINATION

- A. Persons and Property:
 - 1. Carefully protect and guard all trees, shrubs, and vegetation to remain.
 - 2. Take every precaution to avoid damage to utilities, buildings, structures, facilities, and other property. All curbs, gutters, pavements, structures, utility lines, and other features along the street rights-of-way, adjacent property and the existing campus facility shall be protected.
 - 3. Barricades/Enclosures: Properly protect persons and property at all times against harm or damage of any kind during construction and site improvement operations. Provide

substantial barricades/enclosures around all openings as soon as they are uncovered, to block access and afford protection to workmen, facility employees, and the general public.

4. **Signals:** Provide lanterns or other signalization, as may be required by law or directed by the Owner's Designated Representative in the vicinity of any open excavations or unsafe areas, and be certain that such devices are operable at all times during hours of darkness, or when the work area is left unattended.
5. **Shoring/Bracing:** Provide necessary shoring and bracing for support of buildings scheduled for demolition and for protection of adjacent structures and facilities caused by demolition operations. Cost of repair shall be paid by the Contractor and at additional cost to the Owner.
6. Maintain all barricades and signals for the duration of the Contract.

B. Utilities:

1. **Preserve Active Lines:** Preserve in operating condition, all active utilities indicated on the Contract Drawings to remain. This applies to all utilities, which traverse the project site, or exist in the immediate vicinity of the site, including, but not limited to, mains, conduits, manholes, handholes, catch basins, valve boxes, poles, guy anchors, and appurtenances. Damage to any utility line or related appurtenances resulting from work under this Contract shall be repaired or replaced by the Contractor to the satisfaction of the Architect/Engineer, Owner, utility company, utility owner and/or local authority. All costs associated with this repair shall be paid by the Contractor at no additional cost to the Owner.
2. **Damaged Utility Lines:** If active utility lines are broken or damaged during any site improvements operations, take all necessary steps immediately to avoid endangering persons or property, and notify the Owner's Designated Representative, Architect/Engineer, and the affected utility company, and municipal engineer's office to obtain a decision regarding this treatment and/or assistance in the repair of the damaged line.
3. **Prior Notification:** Notify all utility companies, utility owners, municipal engineer's office, and/or the respective water and sewer department, prior to the commencement of any operations on the site. Confirm locations with all utility companies/owners involved, of all live or active lines within, or immediately adjacent to, the contract limit lines of this project.
4. **Water Damage:** In the event that water, storm sewer, sanitary, or other utility lines are broken, or that springs, ground water, or other sources of water are encountered, take all necessary steps immediately to divert water away from construction, site improvement operations and storage areas to prevent erosion, undermining or other damage. If permanent corrective measures other than those indicated on the Contract Drawings become necessary, request a written decision from the Architect/Engineer.

C. Adjacent Properties:

1. **Protection:** Protect all adjacent properties and structures and use every means possible to prevent erosion, flooding, undermining excessive excavation or other damage during any construction or site improvement operations. Repair all damage in a manner specified by, and to the satisfaction of the Owner's Designated Representative and the Architect/Engineer. The Contractor shall pay the cost of any repairs necessary at no additional cost to the Owner.

D. Restoration:

1. Injured or damaged trees shall be repaired in accordance with accepted nursery industry standards and as acceptable to the Architect/Engineer.
2. Contractor shall bear the cost of repair and replacement of trees scheduled to remain that are damaged or removed by construction operations.
3. All trees, shrubs or plantings, which are taken-up for subsequent reuse, and die, shall be replaced with first class balled and burlapped nursery grown representatives of the same species and caliper at the expense of the Contractor.
4. Damage to existing curbs, gutters, pavements, structures, utility lines, or other features should be replaced or repaired to the satisfaction of the Architect/Engineer, Owner's Designated Representative, and/or utility owner, at no additional cost to the Owner.
5. Fill, grade, and compact disturbed areas to the grades and lines as shown on the Contract Drawings. Grade compacted surface to meet adjacent grades and provide proper surface drainage. Provide uniform levels and slopes. All work shall be completed in accordance with specification Division 31 Section "Earth Moving".

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Asphalt base paint specially formulated for horticultural application to cut or damaged plant tissue.
- B. Satisfactory Soil and Granular Material: Requirements for satisfactory soil and granular materials are specified in Division 31 Section "Earth Moving."
 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.
 2. Provide imported granular materials.
 3. Provide imported topsoil.
- C. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
 1. Use coating with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 1. Type: Shredded hardwood.
 2. Size Range: 3 inches maximum, 1/2 inch minimum.
 3. Color: Natural.
- E. Tree- and Plant- Protection Zone Fencing:
 1. The Contractor is to furnish all labor, materials, equipment, and supplies and perform all operations required to complete this work.

2. Protection zone fencing shall be temporary orange construction fence, a minimum of 4-feet in height, mounted to 2-inch x 4-inch wood or steel fence posts, set a maximum of 10 feet o.c. Fence enclosure shall reach the outer limits of the spread of the branches, a minimum radius from face of tree trunk as shown in the Contract Plans, or as determined by the arborist, whichever is greater.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Monuments: Locate, protect and maintain benchmarks, monuments, batter boards, survey control points and other reference points from disturbance during construction. Protect all reference points against movement, injury, and displacement and replace those, which become disturbed as the result of any operations of this Contract. Monuments, benchmarks, and other reference features shall be carefully protected by Contractor. Should any be disturbed or damaged by any cause, the Contractor shall have same replaced to original location, elevation and condition by a NYS Licensed Land Surveyor at the cost and expense of the Contractor.
- B. Verify all limiting boundaries such as permanent and temporary easements, property lines, rights-of-way and grading limits have been accurately located and clearly marked. Where appropriate, verify that pipeline routings and other work limits have been accurately located and clearly marked.
- C. Locate and clearly identify trees, shrubs, and other vegetation to be removed or relocated. Wrap a 1-inch blue vinyl tie tape flag around each tree trunk at 54+/- inches above the ground.
- D. Carefully plan and execute operations so as to avoid damage to trees, shrubs, plants, etc.
- E. Verify that temporary erosion- and sedimentation-control measures are in place.
- F. Protect existing site improvements to remain from damage during construction.
 1. Restore damaged improvements to their original condition, as acceptable to Owner's Designated Representative.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Work shall be completed in accordance with Division 31 Section "Erosion and Sediment Control", the Project SWPPP and SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-15-002).
- B. Comply with all federal, state, and local laws, ordinances, rules, and regulations.
- C. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

- E. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- F. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Prior to the start of any site operations, fence all trees and groups of trees, shrubs or planting beds which may interfere with site operations and are not designated to be removed. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation. Maintain fencing during full construction period. Remove temporary fencing when no longer needed or when acceptable to the Architect/Engineer.
- B. Protect trees against cutting, breaking, bruising of bark. Where, in the opinion of the Architect/Engineer, the Contractor does not exercise reasonable care, the Architect/Engineer may require trunks to be wrapped with protective fencing.
- C. Tie back flexible limbs that may be damaged by passage or activity of equipment beneath trees. Where limbs cannot be tied back and equipment cannot avoid limbs or branches, prune back limbs, only after approval of the Architect/Engineer.
- D. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- E. If recommended by the Arborist, mulch areas inside tree-protection zones and other areas indicated. Apply 4-inch average thickness of organic mulch. Do not place mulch within 6-inches of tree trunks.
- F. Protect Tree- and Plant- Protection Zones. Refer to Part 1 "Project Conditions" for additional information.
- G. Maintain protection zones free of weeds and trash. Mow grass as needed to maintain a 2-to 4-inch grass height.
- H. Trenching near Trees: Obtain arborist approval for work required in root zones and protection zones. Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Tunnel past established trees for a minimum distance of 7 feet each side of the trunk. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.
- I. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

- J. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
- K. Prune roots that are affected by temporary and permanent construction.
1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 2. Cut Ends: Coat cut ends of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 4. Cover exposed roots with burlap and water regularly.
 5. Backfill as soon as possible according to requirements in Division 31 Section "Earth Moving."
- L. Root Pruning at Edge of Protection Zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- M. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
- N. The Contractor will be held responsible for damage to trees as a result of not following the procedures outlined herein, not exercising reasonable care or by negligence.
- O. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect/Engineer or Owner's Designated Representative.
- P. Dead or Dying Trees:
1. All trees, which, upon completion of the project, are found to be in a dead or dying condition (more than 50% dead or in an unhealthy condition) as the result of the failure to adhere to the above precautionary measures, shall be removed to 12 inches below finished grade and replaced, in a designated location, with a tree of like size and species at the expense of the Contractor. The tree shall be guaranteed for a period of 12 months or the project's guarantee period, whichever is longer.
- Q. Damaged Trees:
1. Trees damaged in any manner, but deemed savable, may be repaired to the satisfaction of the Architect/Engineer, by an approved tree surgery company.
 2. Should the repaired tree(s) die within 12 months of final acceptance of the project, the tree(s) shall be removed and replaced as above.
- R. Relocation of Trees/Shrubs/Plants:

1. Dig trees/shrubs/plants during appropriate season and plant immediately in the designated location. Should it be necessary, due to the sequence of work, to delay planting in the new permanent location, dig and store tree/shrubs/plants in accordance with accepted standard practices. Trees may be dug with a tree spade, but must be planted immediately in the permanent or an approved temporary location.

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 1. Notify applicable utility company or utility owner and obtain approval for shutting off and terminating existing utility services.
 2. Perform work in accordance with applicable utility company requirements.
 3. Identify utility service terminations on project record documents. Place markers to indicate location of disconnected utility service below grade.
 4. Notify Owner's Designated Representative in writing when disconnecting and sealing/capping of each utility service is complete.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. The Contractor shall coordinate at least two weeks in advance with the Architect/Engineer, Owner and Owner's Designated Representative to schedule temporary service shut downs needed to complete the work.
 2. Notify Owner's Designated Representative and Owner in writing not less than 48-hours in advance to confirm proposed utility interruptions.
 3. Any one disruption shall not exceed 4-hours unless mutually agreed to by the Owner, Owner's Designated Representative, Architect/Engineer and Contractor.
 4. Temporary service shutdown durations, time of day, and day of the week will be restricted by the Owner. Temporary power, water or sanitary shut downs will not be permitted during normal weekday business hours for the facility/campus. The Contractor shall include in the price bid all costs for labor, equipment and materials necessary to complete the connections when the facility/campus is not in operation (e.g. weekends, holidays, or if approved by the facility/campus weekdays between 5:00 p.m. and 6:00 a.m.). The date, time and duration of any service shutdown shall be mutually agreed upon between the Contractor, Owner's Designated Representative, Owner, and Architect/Engineer, prior to start of work.
 5. Do not proceed with utility interruptions without Owner's Designated Representative written permission.
- C. Excavate for and remove underground utilities indicated to be removed.
- D. Provide bypassing of flows as needed.

3.5 CLEARING AND GRUBBING

- A. All trees shall be "topped" and "limbed" before felling unless otherwise approved.

- B. The Contractor shall schedule and conduct his operations to minimize erosion of soils and to prevent silting and muddying of streams, rivers, wetlands, impoundments and land adjacent to or affected by the work. Erosion control measures shall be implemented and the area of soil exposed by construction at any one time shall be kept to a minimum. Final restoration shall be carried out as soon as possible following completion of clearing and grubbing operations.
- C. Contractor shall protect all existing site utilities, appurtenance and amenities to remain.
- D. All operations shall be done in a manner so that present growth will blend with the limits of construction and a natural appearance will be attained.
- E. Clearing consists of cutting and properly disposing of all trees (designated to be removed) and other vegetation, down timber, snags, stubs, brush, shrubs, bushes, as well as boulders, rubbish, debris, and other objectionable matter and materials occurring within areas to be cleared.
- F. In wooded areas, trees may be removed and/or trimmed as required, for the proper installation of the work. Gross and unnecessary removal of trees is not permitted.
- G. Grubbing consists of the removal and proper disposal of all stumps, roots, duff, grass, turf, sod, debris, vegetation, foundations, buried structures and pipes, as well as other objectionable matter and materials occurring within the areas to be cleared and grubbed.
- H. Remove stumps and roots to their full depth within 5-feet of underground structures, utility lines, footings and concrete or paved surfaces. Remove stumps and roots to a clear depth of 3-feet below subgrade in other locations.
- I. Use hand method for grubbing within protection zones of trees to remain.
- J. Stumps of trees removed shall be grubbed, ground or cut.
- K. All stump holes shall be backfilled and properly compacted to the satisfaction of the Owner's Designated Representative and/or Architect/Engineer. Backfill materials shall include: granular materials meeting NYSDOT Item 304.14 in areas under and within 5 feet of structures or buildings; granular materials meeting NYSDOT Item 304.12 in areas under and within 5 feet of pavements (asphalt, concrete or similar) and utility structures; and, Select Earth in all other areas. Backfilling shall be completed within one (1) week after start of work on the tree. Any open excavation as a result of this work, shall be properly protected to avoid harm to public, facility employees, work, equipment, or others.

3.6 FELLING OR PRUNING TREES

- A. If it is impractical to fell trees as a whole, remove them in sections according to standard practices of professional tree removal. Fall trees to the center of the area being cleared to minimize damage to trees that are to be left standing.
- B. Fall trees away from the slope embankments; stream banks, wetlands, swamps or other water courses; buildings; public or private roadways or sidewalks; and, trees/shrubs to remain.
- C. Fall trees in a manner to minimize damage to existing pavements or structures.

- D. Immediately after felling a tree, remove branches, cut trunk and limbs, and remove all materials from the site. All merchantable timber and wood, which is removed, shall become the property of the Contractor.
- E. All trees to remain shall not come in contact with any machine or appliance that will in any manner injure, sear, or kill them.
- F. All trees left standing, which have been trimmed or become scarred by Contractor's operations, shall be promptly repaired by properly cutting, smoothing, and painting.
- G. Trees to be trimmed shall be evenly cut to achieve neat severance with the least possible damage to trees.
- H. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
 - 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
 - a. Type of Pruning: Cleaning.
 - b. Specialty Pruning: Restoration.
 - 3. Cut branches with sharp pruning instruments; do not break or chop.
 - 4. Do not apply pruning paint to wounds.
 - 5. Chip removed branches and dispose of off-site.
- I. Where roots are cut or damaged, apply wet burlap to prevent drying out.

3.7 TOPSOIL STRIPPING

- A. Prior to any excavation or embankment or as directed by the Architect/Engineer, topsoil shall be removed. Topsoil work, such as stripping, stockpiling and similar work shall not be carried out when soil is wet so that tilth of soil will be destroyed.
- B. Remove sod and grass before stripping topsoil.
- C. Topsoil shall be stripped full depth in building areas, and all areas to be regraded, resurfaced or paved within the contract limit work area. Stripped topsoil shall be stockpiled in a location on site acceptable to the Owner's Designated Representative or Architect/Engineer.
- D. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, stones, and other objects more than 2 inches in diameter; trash, waste, branches, brush, debris, weeds, roots, and other waste materials.
- E. Stockpile cleaned topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water. Provide erosion control measures around stockpiles including, but not limited to, silt fence.

1. Limit height of topsoil stockpiles to 72 inches.
 2. Do not stockpile topsoil within protection zones.
- F. Stockpiled topsoil will be used in finish grading for preparation of lawns and planting beds. No topsoil shall be removed from the site without the prior approval of the Architect/Engineer. All topsoil used in grading shall be screened to remove any materials larger than 2-inches in diameter.
- G. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance to prevent damage to main root system.
- H. If the Contractor fails to strip and stockpile all available topsoil within the limits of areas disturbed by his work, the Contractor shall at no cost to the Owner, import adequate topsoil to cover the disturbed areas to a minimum depth of 4-inches.
- I. If topsoil does not exist, in sufficient quantity, on the site, the Contractor shall deliver, place and spread a sufficient quantity of acceptable topsoil necessary to achieve a depth of 4 inches over the entire area of the site indicated on the contract drawings to receive lawns and planting. Secure all topsoil from an approved source and submit a mechanical and chemical analysis to the Architect/Engineer for any topsoil, which is to be delivered.
- J. If excess quantities of topsoil exist, the Contractor shall notify the Architect/Engineer immediately. The Architect/Engineer will determine whether the Contractor shall screen and spread the excess topsoil on-site in designated areas, leave the excess topsoil properly stockpiled on-site, and/or remove and dispose of the excess topsoil from the site. Contractor's price bid shall include the costs to complete any one or a combination of these alternatives.

3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove all below-grade wood, organic material, and metal construction within demolition or removal area.
- C. Remove slabs, paving, curbs, gutters, and aggregate base as indicated. Remove to the minimum extent possible to complete the work while utilizing existing joints.
1. Prior to full depth removal, saw cut asphalt and concrete paved surfaces. Use a saw, which will cut a neat, straight joint line along line of existing pavements to remain. 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. Carefully remove walks and curbs to the minimum extent possible. Store and protect for reuse if so designated.
- D. All fences, signs, and other obstructions encountered shall be carefully taken-up and stored for subsequent replacement.

- E. Do not disturb property markers unless absolutely necessary. If it becomes necessary to disturb or remove a property marker, have a licensed land surveyor provide four (4) ties to the marker. The licensed land surveyor shall replace the marker as soon as possible.
- F. Remove and turn over to the Owner all items indicated to be salvaged.
- G. Remove, store, protect, and reinstall all items indicated for relocation.
- H. Remove and dispose off-site underground structures and piping indicated for removal on the Contract Drawings.

3.9 REGRADING AT OR ADJACENT TO PROTECTION ZONES

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
 - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.10 BACKFILLING

- A. The Contractor shall be responsible for providing all necessary fill materials to backfill the resultant hole from removal of all plant materials.
- B. Water in sufficient quantity may be required to assure compaction.
- C. Earth and granular materials for backfill, shall be in accordance with Division 31 Section "Earth Moving". Refer to Part 3 "Clearing and Grubbing" of this specification for additional information.
- D. All excavations shall be backfilled to the original surface of the ground or as otherwise specified, or directed. Provide proper surface drainage and provide uniform levels and slopes. Backfilling shall be done with suitable excavated materials approved by the Architect/Engineer, and satisfactorily compacted.
- E. The Architect/Engineer shall be the sole judge of what constitutes unsuitable material for backfill.

3.11 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them in accordance with requirements of all federal, state, local laws and ordinances off Owner's property. Remove cleared materials from the site as the work progresses.
- B. Remove cleared materials from the site as the work progresses. All wood and brush shall be disposed of within 15 days after cutting or felling unless otherwise approved by the Architect/Engineer.
- C. On site burning of combustible cleared materials is not permitted. On site burial of cleared materials is not permitted.
- D. Leave site in a neat and orderly condition.

3.12 DUST & NOISE CONTROL

- A. Complete dust and noise control in accordance with Division 31 Section "Earth Moving".

3.13 DEWATERING

- A. Complete dewatering in accordance with Division 31 Section "Earth Moving".

3.14 MAINTENANCE TRAFFIC

- A. Complete maintenance and protection of traffic in accordance with Division 32 Section "Maintenance and Protection of Traffic".

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

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. Earth and rock excavation
2. Cutting and filling of subgrade
3. Earthen embankments
4. Preparation of subgrade, including excavation and backfill, for buildings, structures, and foundations.
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.
6. Preparing subgrades, including excavation and backfill, for slabs-on-grade, walks, pavements, turf and grasses, and plants
7. Excavation and removal of unsuitable bearing material
8. Soils and backfill materials consolidation and compaction.
9. Grading outside building lines
10. Furnishing and placing earth and granular materials
11. Subbase course for concrete walks and pavements.
12. Subbase course for asphalt paving.
13. Removing from site excess and/or unsuitable fill
14. All other associated earthwork as necessary to perform the work under this Contract in conformance with the alignments, grades and detailed sections provided.

B. Related Sections:

1. Division 03 Section "**Cast-in-Place Concrete**"
2. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground facility utilities and buried utility structures.
3. Division 31 Section "**Site Clearing**"
4. Division 32 Section "**Turf and Grasses**"

C. Special Requirements

1. Upon excavation, the subgrade shall be inspected by a qualified and independent testing representative obtained by the Owner. Subgrade shall be approved by the Owner's representative before any new construction begins. Results of the tests must be reviewed and approved by the Architect/Engineer.
2. All excavation, fill or backfill placement, and utility construction shall be performed in the dry. The contractor shall be prepared to dewater as necessary. Subsurfaces shall be kept free of

water, subjected to minimum amount of construction traffic, exposed no longer than necessary, and not permitted to freeze.

1.3 DEFINITIONS

- A. **Backfill:** Aggregate or earthen material or controlled low-strength material used to fill a-trench excavation.
1. **Initial Backfill:** Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. **Final Backfill:** Backfill placed over initial backfill to fill a trench.
- B. **Bedding Course:** Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- C. **Borrow Soil:** Satisfactory soil imported from off-site (or on-site if permitted) for use as fill or backfill.
- D. **Drainage Course:** Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- E. **Embankment Foundation:** Surface area upon which an embankment or fill is constructed.
- F. **Excavation:** Removal of material encountered to subgrade elevations, lines, and dimensions required and the subsequent disposal of materials removed.
1. **Additional Excavation:** When excavation has reached required subgrade elevations, notify the Owner's Designated Representative, who will make an inspection of the conditions. If Architect/Engineer determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Architect/Engineer.
 2. **Unauthorized Excavation:** Consists of removal of materials beyond required subgrade elevations or dimensions without specific direction of the Architect/Engineer or Owner's Designated Representative. Unauthorized excavation, as well as remedial work directed by the Architect/Engineer or Owner's Designated Representative, shall be at Contractor's expense. Fill of unauthorized excavations shall be as follows:
 - a. Under footings or foundation bases, fill of unauthorized excavations under footing or foundation bases shall be accomplished by extending lean concrete or well-graded crushed aggregate fill to bring elevations to proper position, when acceptable to Architect/Engineer.
 - b. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Owner's Designated Representative.
 3. **Unclassified Excavation:** Unclassified excavation shall consist of the excavation and disposal of all materials or obstructions, of any description, encountered during construction, unless otherwise specified.

- G. Fill: Aggregate and/or earthen soil materials used to raise existing grades.
- H. Loam: Soil mixture consisting of the following proportions:
- | | |
|------|----------|
| Sand | 30 - 50% |
| Silt | 30 - 50% |
| Clay | 0 - 20% |
- I. Rock: Solid hard material located in ledges, bedded deposits and unstratified masses, and all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock, which must be removed by blasting or pneumatic hammers. Rock does not include shale, slate, soft sandstone, hardpan, masonry or concrete rubble, boulders less than 2 cubic yards, such other rock material which is decomposed, stratified, weathered or shattered, or any material capable of being removed by a well maintained Caterpillar 225 power shovel, or equivalent.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, utility structures, pole bases, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Aggregate layer placed between the subgrade and asphalt pavement, concrete pavement, hardscape or stabilized topsoil area.
- L. Subgrade or Subgrade Surface: Uppermost undisturbed surface of an excavation or the top surface of a compacted fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- M. Suitable Material: A material whose composition is satisfactory for use in embankment, backfill, or fill construction. Determinations of whether a specific material is suitable for a specific application shall be made by the Owner's Designated Representative or Architect/Engineer.
- N. Topsoil: Refer to Division 31 Section "Site Clearing".
- O. Unstable Material: (if encountered) Unstable material shall mean debris and all wet, soft, or loose material, which does not provide sufficient bearing capacity to satisfactorily support pipes, structures or other work placed thereon.
- P. Unsuitable Material: Unsuitable material shall mean excavated material, which in the opinion of the Owner's Designated Representative or Architect/Engineer, does not meet specification requirements for backfilling, embankment, or filling purposes and includes unstable material.
1. Unsuitable material shall fall into two specific categories. The first shall be that material which would be unsuitable under any circumstances including unstable materials. This category includes materials containing humus, spongy material, roots, stumps, muck, peat, and any other objectionable material. This material shall be disposed of in an approved off-site spoil area.
 2. The second category shall consist of material, which is unsatisfactory for backfill because of its moisture content at the time of excavation. This material shall be stockpiled in approved areas on the Project site. This stockpiled material, when satisfactory for backfill, as determined by the Architect/Engineer, shall be used in other areas lacking backfill.

3. Excavated materials, which become unsuitable as a direct result of the Contractor's work shall result in rejection of the unsuitable material by the Architect/Engineer.
4. The Owner's Designated Representative or Architect/Engineer shall be the sole judge of what constitutes unsuitable material and into which category it falls.

Q. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Low-strength material, including design mixture.
3. Warning tapes.

B. Material Test Reports: Contractor shall submit test results for laboratory gradation, moisture content (Proctor Tests), and maximum density tests certified by an approved testing laboratory or other requirements on the various imported soil and granular items, from each approved material source, prior to their use on the project:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 1557.

C. Material Test Reports: Contractor shall submit test results for laboratory gradation, moisture content (Proctor Tests), and maximum density tests certified by an approved testing laboratory or other requirements on: various imported soil and granular items, from each approved material source; and, various on-site soils used for the project, prior to their use on the project:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 1557.

D. Contractor shall submit all laboratory and field compaction density tests and retest reports. Contractor's independent testing agency shall be approved by the Architect/Engineer.

E. Provide material certifications for imported materials.

F. Submit list indicating locations where various soil earthen and granular materials will be utilized.

G. List of compaction plans of proposed compaction equipment and description.

H. Copies of measurements and computed volumes of unsuitable material removed shall be submitted to the Architect/Engineer.

I. Details of proposed sheeting, if required, shall be submitted by the Contractor to the Architect/Engineer for review and no sheeting shall be installed until written acceptance from the Architect/Engineer. Sheeting design shall be stamped by NYS licensed professional engineer.

- J. Submit Qualification Data: For qualified independent testing agency.
- K. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 QUALITY ASSURANCE

- A. All finished grades shall be as shown on the Drawings or as specified by the Architect/Engineer. Contractor shall verify that survey benchmark and intended elevations for the work are as indicated. Contractor shall verify existing site conditions.
- B. Contractor's independent testing agency shall be approved by the Architect/Engineer.
- C. Erosion control measures in accordance with Division 31 Section "Erosion and Sediment Control", the Project SWPPP, and the NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-15-002) shall be followed.
- D. When placing fill and backfill, all compaction and soil moisture requirements as delineated in this specification shall be followed. Lift thickness, and the compactive capabilities of the equipment used, shall be continually monitored by the Contractor to obtain the compaction efforts required.
- E. Provide on-site at least one person who shall supervise the soil compaction operations, and who shall be thoroughly familiar with the various types of compaction equipment, proper compacting techniques and methods, and soils behavior, and who shall direct the compaction operations.
- F. It is the responsibility of the Contractor to select, furnish and properly maintain equipment, which will compact the fill uniformly to the required density.
- G. The Architect/Engineer will be the sole judge of the conformance of materials, workmanship, and compaction with the requirements of the Contract Documents.
- H. Work referencing NYSDOT (New York State Department of Transportation) shall be in compliance with the New York State Department of Transportation Standard Specifications (NYSS) dated January 2, 2002 (and any subsequent revisions).
- I. Special Inspections: Owner will engage a qualified special inspector to perform the Special Inspections as outlined in Divisions 1.

1.6 COMPACTION TESTING AND REPORTS

- A. Owner will engage and pay for a qualified and independent testing and inspecting agency to complete field compaction density testing for all soils and granular materials utilized in the Work. All materials not meeting proper compaction requirements shall be removed and replaced. Costs to the Owner for additional testing of replacement materials shall be the responsibility of the Contractor.

- B. Owner will engage and pay for a qualified and independent testing and inspecting agency to take samples and perform tests to determine optimum moisture content, and maximum density testing of various on-site soils to be utilized in the Work. Reports will be provided to the Contractor.
- C. The Owner reserves the right to request testing of all Contractor imported materials to verify conformance with approved materials. All soils and granular materials not meeting the proper gradation requirements nor previously approved laboratory maximum density tests as submitted by the Contractor shall be removed. Costs to the Owner for testing of materials, which are found not in conformance with approved materials, shall be the responsibility of the Contractor.
- D. The taking of samples and the performing of field compaction density tests and laboratory maximum density tests shall be done for the Contractor by an approved independent testing laboratory.
- E. Laboratory test reports:
 - 1. As a minimum, the laboratory maximum density testing reports shall contain the following:
 - a. Laboratory's name.
 - b. Date, time, and specific location from which sample was taken and name of person who collected the sample.
 - c. Moisture - Density Curve plotted on graph paper to as large a scale as is practical with all points used to derive the curve being clearly visible.
 - d. Designation of the test method used.
 - e. The optimum density and moisture content.
 - f. A description of the sample.
 - g. The date the test was performed and the person who performed the test.
 - h. The project name, identification, and contractor's name.
 - i. The signature of a responsible officer of the testing laboratory certifying to the information contained in the report.
 - 2. As a minimum, the field compaction density testing reports shall contain the following:
 - a. Testing Agency name.
 - b. Date, time, depth, and specific location at which the test was made and the person's name who performed the test.
 - c. Designation of the test method used.
 - d. Designation of the material being tested.
 - e. Test number.
 - f. In place dry density and moisture content.
 - g. Optimum density and moisture content.
 - h. Percentage of optimum density achieved.
 - i. The project name, identification, and contractor's name.
 - j. The signature of a responsible officer of the testing agency certifying to the information contained in the report

1.7 PROJECT CONDITIONS

- A. When work is in public rights-of-way, the Contractor shall make necessary arrangement for permits, as required, at no extra cost to the Owner.

- B. The Contractor shall be required to ascertain the complete extent of all permits required governing dewatering operations, and shall be bound by their conditions and provisions.
- C. Provide and maintain emergency ingress/egress to the site at all times. Provide and maintain pedestrian and vehicle access to active facility, including but not limited to designated doors, sidewalks, and parking areas.
- D. If trench widths and depths are exceeded, concrete cradles or other special installation procedures may be required and shall be provided where directed by Architect/Engineer. All additional costs, including the cost of redesigns, shall be borne by Contractor.
- E. Moisten or dry backfill materials to the proper moisture content as determined in accordance with ASTM D1557, Method C in order to obtain proper compaction.
- F. Utilities shown on the Contract Drawings are for the convenience of the Contractor, exact locations are not guaranteed. The Contractor shall verify existing utilities with the proper authorities.
- G. Notify Dig Safely New York (UFPO) prior to commencing any excavation. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Provide adequate means of protection of utilities and services, which are not designated to be removed. Repair utilities damaged during site work operations at Contractor's expense.
- H. The project site Owner is not a member of Dig Safely New York. The Contractor alone shall be responsible to locate all utilities and services outside the public rights-of-way. The Contractor shall complete test pits as needed to confirm underground utilities and services. The cost of all test pits shall be included in the price bid. Provide adequate means of protection of utilities and services, which are not designated to be removed. Repair utilities damaged during site work operations at Contractor's expense.
- I. Minimize interference with adjoining roads, streets, walks, parking areas and other adjacent occupied or used facilities during earth moving operations. Refer to Division 32 Section "Maintenance and Protection of Traffic" for traffic maintenance information.
- J. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Owner's Designated Representative.
- K. Locate, protect, and maintain benchmarks, monuments, control points, and project engineering reference points. Reestablish disturbed or destroyed items at Contractor's expense.
- L. The control of dust, noise, erosion, and sediment originating from construction operations is considered a critical responsibility of the Contractor. The Owner's Designated Representative will be the final judge of the adequacy of the Contractor's dust, noise, erosion, and sedimentation control. Work may be suspended by the Owner's Designated Representative until adequate dust, noise, erosion, and sedimentation control is attained.

- M. Protect structures, utilities, sidewalks, pavements, buildings, and other services or facilities on site and adjacent to the site from damage caused by earth moving operations or other work in support of Contractor operations. Cost of repair and restoration of damaged items shall be at Contractor's expense.
- N. The Contractor shall take precautions to protect from harm the work of other contractors on site, existing facilities, as well as adjacent property. The Contractor shall be responsible for all damage or injury done to pipes, structures, utilities, pavement, buildings, property or person as a result of work performed to complete this contract. The Contractor at his own expense shall repair or replace such property or item to the satisfaction of the property owner, utility owner, public agency having jurisdiction, Architect/Engineer and Owner's Designated Representative.
- O. When it is necessary to haul materials over the streets or pavements, the Contractor shall provide suitable tight vehicles so as to prevent deposits on the streets or pavements. In all cases, where any materials are dropped from the vehicles, the Contractor shall clean up the same as often as directed and keep the crosswalks, streets, pavements and drainage ways clean and free from dirt, mud, stone, and other hauled materials.
- P. Contractor shall be responsible for cleaning private and public; roads, parking areas or walkways, of any material carried onto these roads or pavements by trucks or other equipment completing work in support of this project. Associated costs shall be included in price bid.
- Q. The following practices are prohibited within tree- and/or plant-protection zones:
1. Storage of or stockpiling of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
 8. Do not direct vehicle or equipment exhaust towards protection zones.
 9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
 10. Do not store materials potentially harmful to tree roots. Potentially harmful materials include, but are not limited to petroleum products, cement, lime, paints, detergents, acids and cleaning agents.
- R. The Owner and Architect/Engineer do not guarantee that all required excavation can be executed by use of machinery. In some cases, it may be necessary to revise proposed alignments, which may preclude the use of machinery. In this event, the Contractor shall be required to perform this work by any method at the same price(s) bid in the Proposal, with no additional compensation due to the inability to use machinery.
- S. The existing ground elevations as shown on the Drawings are believed to be reasonably correct. The Contractor shall satisfy himself, however, by actual examination of the sites of the work, as to the

existing elevations and the amount of work required under this section. No claim shall be made by the Contractor for additional compensation for conditions other than that shown.

- T. The Contractor shall remove any waste material or other debris that has accumulated as a result of the work of this section and dispose in conformance with applicable legal requirements and in a manner acceptable to the Owner's Designated Representative or Architect/Engineer.
- U. Soil reports and boring logs: Refer to Attachment Geotechnical Report.

1.8 STORAGE AND HANDLING

- A. Stockpiling of earth spoil or excess earth material on the site or storage of excavated materials for reuse shall be done in a manner which will not hinder the progress of the work; cause any nuisance; or cause spillage or tracking of materials from the transporting vehicle onto public or private roadways, parking areas, sidewalks or pavements, or cause an inconvenience to adjacent property owners or tenants, general public, other contractors, or facility operations.
- B. Obstruction of roads, driveways, parking areas, sidewalks, or interference with drainage along curbs, gutters, ditches, or drainage channels with stored material is not permitted.
- C. On-site topsoil suitable for final placement and grading shall be excavated and stockpiled on-site for future use in accordance with Division 31 Section "Site Clearing". Imported topsoil shall be stockpiled on-site in a separate location from on-site topsoil. Each stockpile shall be well-shaped and graded in order to shed water and to avoid contamination by other granular or earth materials temporarily stockpiled on-site. Provide erosion control (silt fence) around stockpiles.

1.9 SCHEDULING

- A. If required to complete the work properly, the Contractor shall obtain grading releases from property owners near trenching or other grading operations at least ten (10) days before commencement of the work.
- B. Do not commence site earth moving operations until temporary erosion- and sedimentation-control and tree- and plant-protection measures are in place.
- C. Allow time to rework, screen and moisture condition on-site and/or imported soils for placement.
- D. Except by permission of the Architect/Engineer, not more than 200 feet of trench shall be opened at any one time. Not more than 100 feet of trench may be opened in advance of the completed pipe laying operations; and not more than one street crossing may be obstructed by the same trench at any one time.
- E. Schedule the work to allow ample time for laboratory tests and to permit the collecting of samples and the performing of field density tests during the backfilling and compaction operations.
- F. All subgrades shall be approved by Architect/Engineer or Owner's Designated Representative before pipes, structures, and facilities are installed or concrete is placed. Results of the tests must be reviewed and approved by the Architect/Engineer.

- G. Do not backfill against concrete elements until bearing surfaces have reached design strength or are properly braced and backfilling operations are approved.
- H. Compaction shall not take place in freezing weather or when materials to be compacted are frozen, too wet or moist, or too dry.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. **Common Earth:** (for use under nonpaved areas located at least 5-feet outside building/structure limits only) - Sand, loam, gravel, or similar materials free from debris, frozen materials, organic materials, or other deleterious material, and containing some rock fragments, stones, and pebbles, not exceeding 4 inches in their largest dimension and meeting the following requirements:

1. Plasticity index of not more than 30 - ASTM D424.
2. Minimum laboratory dry weight at optimum moisture content of 110 pounds per cubic foot.

Provide imported Common Earth fill materials as required to complete the work. Contractor shall obtain rights and pay all cost for imported materials.

Proposed Common Earth fill (imported or site excavated) material shall be inspected, tested, and laboratory report issued prior to use in the work.

- B. **Select Earth:** Sand, gravel, and similar material which shall be free from silt, clay, loam, organic material, roots, debris, waste, frozen material, or other deleterious materials, and shall only contain small amounts (less than 10 percent) of stone, pebbles, or lumps over one inch in greatest dimension, but none over 2 inches in greatest dimension.

Imported select earth materials shall meet requirements of the NYSDOT Standard Specification Section 203-2.02C except that no material shall exceed 2-inches in their largest dimension.

- C. **Imported Topsoil:** Imported topsoil shall meet the requirements of NYSDOT Specification Section 713-01, except provide 6 percent minimum organic material. The Contractor shall be responsible for amending imported topsoil with approved materials and by approved methods to meet these requirements and in accordance with Division 32, Section "Turf and Grasses", at no additional cost to the Owner. The material shall be stockpiled, tested and approved by Owner's Designated Representative prior to use on the project. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4-inches deep; do not obtain from bogs or marshes.

- D. Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

- E. Acceptance of all types of soil materials shall be based on the above requirements, and the Owner's Designated Representative or Architect/Engineer shall make final acceptance. Such acceptance or rejection of materials is binding upon the Contractor.

2.2 GRANULAR MATERIALS

- A. **Cushion Sand:** The material shall meet the requirements of NYSDOT Standard Specification Section 703-06, Cushion Sand.
- B. **Bedding Sand:** Sand shall consist of clean, hard, durable, uncoated particles, free from lumps of clay and all deleterious substances. When dry, the sand shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1/4 inch	100
No. 50	0-35
No. 100	0-10

The sand may be determined to be unacceptable if it contains loam or silt in excess of 10 percent of the total volume.

- C. **Crushed Stone:** Material shall be clean, sound, crushed stone of uniform quality. It shall be a 50-50 mixture of NYSDOT primary size designation #1 and #2 stone as per NYSDOT Standard Specifications, Section 703-02, Material Designation 703-0201. Mixture shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1-1/2 inch	100
1 inch	95-100
1/2 inch	45- 57.5
1/4 inch	0 - 7.5

- D. **Crushed Stone (Pavement Drainage Layer):** Material shall be clean, sound, crushed stone of uniform quality. It shall be NYSDOT primary size designation #1 stone as per NYSDOT Standard Specifications, Section 703-02, Material Designation 703-0201.
- E. **Subbase Material (Crusher Run):** Shall meet the requirements of NYSDOT Standard Specification Section 304-2, material designation 733.0402 – Subbase Course, Type 2.
- F. **Engineered Fill (run-of-bank gravel):** Material consisting of hard, durable particles and shall meet the requirements of NYSDOT Standard Specification Section 304-2.02, Material Designation 733.0404, Subbase Course, Type 4. Maximum particle size 2-inches, less than 40% by weight passing the No. 40 sieve and less than 10% by weight passing the No. 200 Sieve.
- G. **Select Granular Fill:** The material shall meet the requirements of NYSDOT Standard Specification Section 203-2.06, Material Designation 733.1101, for Select Granular Fill.
- H. **Select Structural Fill:** The material shall meet the requirements of NYSDOT Standard Specification Section 203-2.13, for Select Structural Fill.

- I. **Underdrain Filter Material:** Shall meet the requirements of NYSDOT Standard Specification Section 605-2.02, Type II Underdrain Filter Material.
- J. **Underdrain Sand Filter Material:** (Use with Type 1 Corrugated HDPE Underdrain only) Shall be coarse and medium sand meeting the following size range:

Sieve Size	% Passing
#10	97-100%
#18	85-100%
#60	0-20%
#100	0-3%

- K. **Pea Gravel:** Shall be screened, washed gravel meeting the gradation requirements of NYSDOT primary size designation #1A stone as per NYSDOT Standard Specifications, Section 703-02.
- L. **Light and Medium Stone Fill:** The material shall meet the requirements of NYSDOT Standard Specification Section 620-2.02 for light and medium stone fill.
- M. Acceptance of all types of fill shall be based on the above requirements, and the Architect/Engineer shall make final acceptance. Such acceptance or rejection of materials is binding upon the Contractor

2.3 GEOTEXTILES

- A. **Pavement Stabilization Geotextile Fabric:** The geotextile fabric for pavement stabilization shall be Mirafi 500X as manufactured by Mirafi, AMOCO 2002, Synthetic Industries 200ST or approved equal. The geotextile fabric shall be woven fabric of only continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew, and rot resistant. The fabric shall be UV stabilized.

<u>Fabric Properties – Mirafi 500x</u>	<u>Acceptable Value</u>	<u>Test Method</u>
Grab Tensile Strength, kN (lbs)	0.9 (200)	ASTM D4632
Elongation at Failure, % MD/ CD	15/ 10	ASTM D4632
Mullen Burst Strength, kPa (psi)	2756 (400)	ASTM D3786
Trapezoidal Tear Strength, kN (lbs)	0.33 (75)	ASTM D4533
Puncture Strength, kN (lbs)	0.40 (90)	ASTM D4833
Apparent Opening Size (AOS)	50	US Std. Sieve
	0.30 mm	ASTM D4751
Permittivity, sec ⁻¹	0.05	ASTM D4491
Flow Rate, l/min/m ² (gal/min/sf)	200 (5.0)	ASTM D4491
UV Resistance after 500 hrs, % strength	70	ASTM D4355

- B. **Woven Separation Fabric:** The geotextile fabric for pavement stabilization shall be Mirafi 550X as manufactured by Mirafi, US Fabrics US250, Carthage Mills FX-60, or approved equal. The geotextile fabric shall be woven fabric of only continuous chain polymeric filaments or yarns of

polyester. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew, and rot resistant. The fabric shall be UV stabilized.

<u>Fabric Properties – Mirafi 500x</u>	Acceptable	
	<u>Value</u>	<u>Test Method</u>
Grab Tensile Strength, kN (lbs)	1.1 (270)	ASTM D4632
Grab tensile Elongation % MD	15	ASTM D4632
Trapezoidal Tear Strength, kN (lbs)	0.445 (100)	ASTM D4533
CBR Puncture Strength, kN (lbs)	3.33 (750)	ASTM D6241
Apparent Opening Size (AOS)	40	US Std. Sieve
	0.43 mm	ASTM D4751
Permittivity, sec ⁻¹	0.05	ASTM D4491
Flow Rate, l/min/m ² (gal/min/sf)	163 (4.0)	ASTM D4491
UV Resistance after 500 hrs, % strength	70	ASTM D4355

- C. **Pavement Stabilization Geotextile Fabric:** The geotextile fabric for pavement stabilization shall be Mirafi HP370 as manufactured by Mirafi, Carthage Mills FX-225MF, US Fabrics US2700/40 or approved equal. The geotextile fabric shall be woven fabric of only continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew, and rot resistant. The fabric shall be UV stabilized.

<u>Fabric Properties – Mirafi HP370</u>	Acceptable	
	<u>Value</u>	<u>Test Method</u>
Grab Tensile Strength, lbf	400 x 250	ASTM D4632
Elongation at Failure, % MD/ CD	15 x 10	ASTM D4632
Trapezoidal Tear Strength, lbf	170 x 125	ASTM D4533
Puncture Strength, lbf	180	ASTM D4833
Apparent Opening Size, US Std. Sieve	40	ASTM D4751
Permittivity, sec ⁻¹	0.9	ASTM D4491
Flow Rate, gal/min/sf	40	ASTM D4491
UV Resistance after 500 hrs, % strength	80	ASTM D4355

<u>Fabric Properties – Mirafi HP370</u>	Acceptable	
	<u>Value</u>	<u>Test Method</u>
Tensile Strength (ultimate) , lb/ft	3600 MD	ASTM D4595
Tensile Strength (at5% strain) lbs/ft	1500 MD	ASTM D4595
Apparent Opening Size, US Std. Sieve	40	ASTM D4751
Permittivity, sec ⁻¹	0.9	ASTM D4491
Flow Rate, gal/min/sf	40	ASTM D4491
UV Resistance after 500 hrs, % strength	80	ASTM D4355

- D. **Drainage Separation Geotextile Fabric:** The geotextile fabric for separation around the underdrain shall be a non-woven fabric such as Mirafi 140N as manufactured by Mirafi, or approved equal.

<u>Fabric Properties – Mirafi 140N</u>	Acceptable	
	<u>Value</u>	<u>Test Method</u>
Grab Tensile Strength, kN (lbs)	0.53 (120)	ASTM D4632
Grab Tensile Elongation, % MD	50	ASTM D4632
Trapezoidal Tear Strength, kN (lbs)	0.22 (50)	ASTM D4533
CBR Puncture Strength, kN (lbs)	0.30 (310)	ASTM D4833
Apparent Opening Size (AOS)	70	US Std. Sieve
	0.212 mm	ASTM D4751
Permittivity, sec. ₁	1.7	ASTM D4491
Flow Rate, l/min/m ² (gal/min/sf)	5500 (135)	ASTM D4491
UV Resistance after 500 hrs, % strength	70	ASTM D4355

- E. **Drainage Separation Geotextile Fabric:** The geotextile fabric for separation around the underdrain shall be a non-woven fabric such as Mirafi 160N as manufactured by Mirafi, or approved equal.

<u>Fabric Properties – Mirafi 160N</u>	<u>Acceptable Value</u>	<u>Test Method</u>
Grab Tensile Strength, kN (lbs)	0.71 (160)	ASTM D4632
Grab Tensile Elongation % MD	50	ASTM D4632
Trapezoidal Tear Strength, kN (lbs)	0.27 (60)	ASTM D4533
CBR Puncture Strength, kN (lbs)	1.83 (410)	ASTM D4833
Apparent Opening Size (AOS)	70	US Std. Sieve
	0.212 mm	ASTM D4751
Permittivity, sec. ₁	1.5	ASTM D4491
Flow Rate, l/min/m ² (gal/min/sf)	4481 (110)	ASTM D4491
UV Resistance after 500 hrs, % strength	70	ASTM D4355

2.4 ACCESSORIES

- A. **Warning Tape:** Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility in bold readable lettering; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
- B. **Detectable Warning Tape:** Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility in bold readable lettering, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30-inches deep; colored as follows: (Detectable warning tape shall be a minimum of 12-inches wide for utilities where Drawings indicate tape shall be buried greater than 30-inches.)
1. Red: Electric.
 2. Yellow: oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.
- C. **Tracer Wire:** shall be 10 AWG stainless steel tracer wire. The wire shall be extended into tracer wire boxes with adequate excess wire to extend 2 feet above grade.
- D. **Tracer Wire Boxes:** Tracer wire boxes in lawn areas shall be 4-inch shaft cathodic protection test boxes Model P445 DT Test as manufactured by Bingham & Taylor or approved equal. Provide cast iron rim and pentagon nut lid. Lid shall be blank with no lettering. Body of box shall be ABS plastic.

1. Box shall be 3-foot in length with standard base.
2. Provide each box with a terminal block containing four terminals.
3. The box shall not transmit shock or stress to the tracer wires and shall be plumb with the box cover flush with the surface of the finished grade.

2.5 COMPACTION

- A. Utilize the proper compaction methods and equipment to suit the soils and conditions encountered. Mechanical, vibratory, pneumatic tampers or other method as approved by the Architect/Engineer shall be required.
- B. Provide water in sufficient quantity as needed to assure compaction.

2.6 DEWATERING, DUST AND NOISE CONTROL

- A. Provide all equipment and materials necessary to perform dewatering and dust control operations in a safe and satisfactory manner. Conform to the New York State Standards and Specifications for Erosion and Sediment Control, and Division 31 Section "Erosion and Sediment Control" for proper operations.
- B. Standing water and/or saturated, unstable soil conditions will not be tolerated in areas to receive foundations, utilities, pavers, skinned infields or asphalt or concrete pavements.
- C. Provide noise suppression enclosures, if required and as determined by the Architect/Engineer. Enclosures, if required shall meet minimum requirements of 3/8-inch plywood enclosure lined with 2-inch rigid insulation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain erosion and sedimentation controls during earth moving operations.
- B. Before placing subsequent materials remove temporary protection installed to protect subgrades and foundation soils from freezing temperatures and frost.
- C. Prior to start of work, the Contractor's surveyor shall verify that all boundaries of temporary and permanent easements and property lines are clearly marked in the field so that the work will not violate these boundaries.
- D. The Contractor and his surveyor shall verify the locations and character of structures, underground lines, and subsurface conditions and verify that the described work will not adversely affect them.
- E. The Contractor's Surveyor shall verify that grade stakes have been properly and accurately set.

F. The Contractor shall be responsible for providing all necessary fill materials.

3.2 METHODS OF CONTROL FOR EXCAVATIONS AND GRADING

A. The Contractor shall employ at the site a licensed surveyor responsible for the proper layout of utilities, structures, and drainage. He shall maintain adequate stakeout control for inspection of the work and to accurately complete construction.

B. The alignment and depth of subgrades of all pipe trenches shall be determined by overhead grade lines or laser at Contractor's option, installed and maintained by his surveyor.

C. In the event that rock is encountered, the Contractor will take cross sections of the rock uncovered. No removal shall begin until adequate time has been given the Owner's Designated Representative or Architect/Engineer for inspection and to verify the measurement of rock material

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EARTH MOVING, GENERAL

A. The work shall be performed by methods acceptable to the Owner's Designated Representative or Architect/Engineer.

B. Excavation shall include the satisfactory removal and disposal of all materials encountered, regardless of the nature of the materials, or the manner in which they were excavated, except materials classified as rock excavation.

C. Excavate to subgrade elevations. Do not excavate rock until it has been classified and cross sectioned.

D. All pipe lines or existing structures encountered during the excavation operation and designated to remain shall be properly supported/protected to prevent damage.

E. Erosion and sedimentation control measures meeting the requirements of Division 31 Section "Erosion and Sediment Control" shall be used around all earthen material stockpiles.

F. Provide and maintain adequate temporary crossovers for pedestrian and vehicular traffic, including temporary gravel drives, steel plates, guardrails, lamps, flags; remove same when necessity for such protection ceases. All traffic maintenance shall be done in a manner satisfactory to the Owner's Designated Representative or Architect/Engineer.

G. Provide and maintain suitable temporary crossings over open trenches where necessary to maintain access for other Contractors, the Architect/Engineer or general public (if applicable).

- H. The Contractor shall have available a supply of steel plates with minimum dimensions of 4 feet x 8 feet x 1 inch, or thicker, as required by jurisdictional authorities and to maintain emergency access and egress to the site. The plates shall be used to bridge open trenches crossing roadways, or driveways as directed by the Architect/Engineer. When used, they shall be secured against the possibility of shifting or dropping into the excavation. During winter months, these plates shall not be left in the roadway or driveway overnight unless specifically required by the Architect/Engineer.
- I. When excavating in or adjacent to the traveled portion of highways, driveways, or parking areas take whatever measures are necessary to protect the road/drive/parking surfaces from becoming undermined.
- J. Protect trees indicated to remain in accordance with Division 31 Section "Site Clearing".
- K. All traffic maintenance shall be done in a manner satisfactory to the Architect/Engineer.

3.5 SOIL STABILIZATION

- A. Sloped sides of excavations shall comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling and/or filling.
- B. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, etc. in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.
- C. Daily inspections of excavations shall be made by an authorized competent representative of the Contractor performing the excavation work.

3.6 DRAINAGE/DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
 - 1. Surface and ground water shall be intercepted and removed before entering excavations. All necessary measures shall be taken. Earth dikes, ditches or other devices, if required, shall be constructed to prevent such flows.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 - 2. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations.

3. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
- C. The Contractor shall at all times provide and maintain proper and satisfactory means and devices (i.e. ditches, temporary pipes, pumps, and/or other temporary construction) for the removal of all water entering the excavations. Water shall be removed as fast as it may collect, in such manner that shall not interfere with the execution of the work or in the proper placing of pipe, structures or other work.
- D. The Contractor shall make his own determination as to required dewatering operations necessary to complete the work. Contractor shall have available at all times sufficient equipment, machinery, piping, and appurtenances for pumping water to keep excavations free from water during construction.
- E. Where the presence of fine grained subsurface materials and high groundwater table may cause the upward flow of water into the excavation with a resulting quick or unstable condition, the Contractor shall install and operate a well point system to prevent the upward flow of water during construction.
- F. All water removed from the trenches or excavations by pumping, bailing, siphoning, well-points, or other means shall be disposed of in such a manner so as to avoid damage to the work, work of other Contractors, surface and ground water, persons or property. Unless otherwise permitted by the Architect/Engineer, groundwater encountered within the limits of excavation shall be depressed to an elevation not less than 12 inches below the bottom thereof before pipe laying, concreting or masonry is started, and shall be so maintained until concrete and joint material have attained adequate strength.
- G. The Contractor shall not discharge water from dewatering operations directly into any line or intermittent stream, channel, wetlands or surface water. The Contractor shall not discharge water from dewatering operations directly into the storm or sanitary sewer system without prior approval of the Architect/Engineer. If the quality of the trench water is not better than or equal to that of the receiving stream, the Contractor shall perform all work necessary to improve the quality of the removed water in accordance with all requirements of the agencies having jurisdiction. This work shall include, but not be limited to, filtration, settling, and screenings meeting the requirements of the New York State Standards and Specifications for Erosion and Sediment Control to reduce the amount of sediment contained in the water to allowable levels, as acceptable to the Architect/Engineer, prior to disposal.
- H. All costs to ensure proper drainage, dewatering and discharge from dewatering operations shall be at the Contractor's expense.
- I. The Contractor shall be responsible for repairing, at his own expense, any ruts, gullies, sloughage, slides, and cleaning or repairing any catch basins or storm drainage lines which display signs of silt build-up during the course of construction until the contract is complete.
- J. Provide adequate protection from the effects of possible uplift due to storm or groundwater where buoyancy might lift installed work or cause joint or structure failure during construction.

- K. Protect the interior of installed work from the entering and accumulation of liquids, ice, and snow. Immediately remove and dispose any accumulation, which may occur.
- L. Adjust, repair, replace, or clean all work, surfaces, and property, which may have been damaged as a result of any dewatering operation.

3.7 EARTH FILL

- A. Unless otherwise specified, shown on the Contract Drawings, or directed by the Owner's Designated Representative or Architect/Engineer, trench and utility backfill material and earth fill located 5 feet outside pavement, building or structure limits shall be Common Earth while, earth fill to subgrade (where earth fill is permitted) located under or within 5 feet of buildings, structures or pavements shall be Select Earth.
- B. To the extent it is available, Common Earth and Select Earth fill material shall consist of approved on-site materials excavated and removed to accommodate new construction. On-site soils modifications including screening and soils conditioning to meet gradation and compaction requirements will be required. When there are insufficient approved suitable materials on-site, import additional material from off-site at no additional cost to the Owner. The Contractor shall obtain all permits necessary to furnish off-site borrow.
- C. The excavated material to be used for trench or structure backfilling or earth fill shall be stored and properly protected by the Contractor so that it will remain suitable for the intended reuse. Excavated materials, which become unsuitable as a direct result of the Contractor's work or lack of protections shall result in rejection of the unsuitable material by the Architect/Engineer.
- D. No payment will be made for stockpiling, rehandling, transporting, removing, or disposing of any materials, which become contaminated or unsuitable and are subsequently rejected by the Architect/Engineer. No payment will be made for additional imported materials required to make up the deficiency in backfill or fill resulting from these rejected materials.
- E. No extra payment shall be made for any excavating, stockpiling, rehandling, transporting, or disposing of any unsuitable material, the cost shall be included in the price bid. Any deficiency in backfill or fill shall be made up in spoil, if suitable and appropriate for application or by imported material acceptable to the Owner's Designated Representative or Architect/Engineer. No payment shall be made for making up any deficiency; the cost of such shall be included in the price bid.

3.8 SOIL CONDITIONING

- A. Provide all wetting, drying, mixing and screening equipment and materials necessary to condition on-site soils to optimum moisture for compaction and required gradation.
- B. Allow time to rework, screen and moisture condition on-site soils for placement.
- C. If in the opinion of the Owner's Designated Representative or Architect/Engineer, the Contractor does not take reasonable care to protect and prepare suitable on-site soils for project use, the

Contractor shall provide suitable imported materials at no additional cost to the Owner. Suitable imported materials shall include granular materials meeting NYSDOT Item 304.14 in areas under and within 5 feet of structures or buildings; granular materials meeting NYSDOT Item 304.12 in areas under and within 5 feet of pavements and utility structures; and, Select Earth in all other areas. Excess unsuitable materials replaced by imported materials shall be removed at no additional cost to the Owner. Refer to Part 1 “Summary – Special Requirements” and the geotechnical report for additional information regarding reuse of on-site soils.

- D. Moisture Control: Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
- E. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to permit compaction to specified density.
- F. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.9 MANNER OF EXECUTION

- A. Materials for reuse on the project shall be stockpiled in an approved designated area adjacent to the work site. Suitable excavated material to be used for trench backfill or earthen fill shall be properly segregated by the Contractor to avoid mixture with topsoil or other unsuitable materials. Contamination of the excavated material as a direct result of the Contractor’s work shall result in rejection of the contaminated material by the Owner’s Designated Representative or Architect/Engineer.
- B. The excavated material to be used for trench backfill or earthen fill shall be stored so that it will cause a minimum of inconvenience to public travel, active facility, adjacent owners or tenants and other contractors or subcontractors. Excavated material shall not be stored in the roadway, parking areas or sidewalks at any time.
- C. Conduct operations in a manner, which will keep the work free of standing and flowing water and dispose the water so as not to damage or create a nuisance to the work, the public, surface, groundwater, and adjacent properties.
- D. The accumulation of liquids, ice and snow in excavation, trenches, areas to be graded, and adjacent areas during construction is not permitted.
- E. Keep graded surfaces well drained, but avoid erosion. Do not place earth or granular fill on wet grade, in water, or over frost, ice or snow. Excavations shall be maintained free of water.

- F. Pipe trenching, building foundations, and structural undercuts: Under normal conditions, the excavation shall be vertical open cut from the ground surface. Tunneling beneath trees and certain surface structures may be required.
- G. Bottom of excavations shall be finish graded by hand methods to receive bedding. The stone bedding shall be placed, compacted, and trimmed by hand to ensure the grade as necessary or as detailed.
- H. Trench sheeting and bracing shall be placed as required to meet local, state and federal safety regulations.
- I. The Architect/Engineer reserves the right to order sheathing and bracing left in place where removal may create damage or impair integrity of the work.

The right of the Architect/Engineer to order sheathing and bracing left in place shall not be construed as creating any obligation on his part to issue such orders. His failure to exercise his right to do so shall not relieve the Contractor of any liability for damages to persons or property occurring from or upon the work of constructing the sewer, water main, or appurtenances occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheathing and bracing to prevent the caving or moving of the ground, or disturbance of the completed work or any of the subsurface structures.
- J. As required, the Contractor may add sufficient water during compaction to assure a complete consolidation of the material. This work shall be at no additional cost to the Owner. Where, in the opinion of the Owner's Designated Representative or Architect/Engineer, adequate consolidation is not being obtained, additional density tests may be ordered at the expense of the Contractor.
- K. The Contractor shall make up any settlement of trenches or embankments with suitable material and stabilize at no additional cost to the Owner. This work shall be performed promptly and as directed by the Owner's Designated Representative

3.10 GRADING

- A. General: Excavate, transport, place, compact and uniformly grade areas within the project limit (including excavated and filled sections and adjacent transition areas) to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 3. The degree of finish shall be that is ordinarily obtainable from either a blade, grader or scraper operations.
 4. Subgrade surfaces shall drain, be compacted, and well graded.
- B. Temporary Ditches, Swales: Install temporary or permanent diversion ditches and/or temporary pumps and take other steps as may be required to effectively eliminate potential water damage in

accordance with the Division 31 Section "Erosion and Sediment Control" or instructions received from the Architect/Engineer.

- C. The Contractor shall be responsible to subtract from finished grades shown on the plans the depths indicated on the Contract Drawings to ensure that the proper subgrade elevations are established. Any questions regarding subgrade elevations shall be answered by the Architect/Engineer. The Architect/Engineer's decision shall mandate.
- D. Site Rough Grading:
1. Unauthorized Excavation: Do not perform excavation work for any purposes other than those indicated on the Contract Drawings, unless so directed by the Architect/Engineer.
 2. Slope grades to direct water away from buildings and to prevent ponding.
 3. Finish subgrades to required elevations within the following tolerances:
 - a. Turf, Planted Areas or Unpaved Areas: Plus or minus 1 inch.
 - b. Walks: Plus or minus 1 inch.
 - c. Pavements and slabs: Plus or minus 1/2 inch.
- E. Grading under and within 10 feet of Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.
- F. Slopes: All swales shall be finished to drain readily. Unless otherwise indicated on the Contract Drawings, the surface of the subgrade in areas to receive lawns shall have a minimum slope of 2% unless otherwise agreed upon by the Architect/Engineer. All areas shall have positive drainage.
- Round tops and bottoms of all slopes and drainage swales. Adjust slopes at intersections of cuts and fills and warp to flow into each other or into the natural ground surface without noticeable break. Establish earth at tops and bottoms of rock ledges in accordance with instructions received from the Architect/Engineers and in a manner that will prevent erosion.
- G. Following stripping, the subgrade shall be compacted sufficiently to develop required compaction to a depth of at least 12 inches. Within building, pavement and retaining wall limits, no fill shall be placed until the subgrade has been proofrolled and approved by the Architect/Engineer. If subgrade ruts, waves or quakes during proofrolling, recompact or replace the unacceptable areas and proofroll again. Repeat process until satisfactory results are obtained as approved by the Architect/Engineer.
- H. The Contractor shall dispose of excess excavated material in accordance with Part 3-Disposal.

3.11 EXCAVATIONS BELOW SUBGRADE

- A. In case earth materials encountered at subgrades are unsuitable, the Contractor shall immediately notify the Architect/Engineer and shall excavate from the limiting subgrades shown or specified, to such new lines and grades, as will be ordered. Excavation below subgrade shall be done only upon express orders of the Owner's Designated Representative or Architect/Engineer.
- B. At subgrade in pavement areas any loose, soft, wet, frozen, organic, or otherwise unsuitable material shall be removed.

- C. Whenever excavations are carried beyond or below the lines and grade shown on the Plans, or as given or directed by the Owner's Designated Representative or Architect/Engineer, all such over-excavation shall be backfilled with special backfill such as: engineered fill; concrete or other materials as directed by the Owner's Designated Representative or Architect/Engineer.
1. Fill over-excavations under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Whether over-excavation was directed by the Owner's Designated Representative or Architect/Engineer or unauthorized, backfill shall be 2,500 psi concrete.
 2. Fill authorized or unauthorized over-excavations below other construction, pipe, or conduit as directed by Owner's Designated Representative.
 3. In pavement areas fill over-excavations with Engineered Fill.
- D. Special backfill materials ordered by the Architect/Engineer as a result of unauthorized over-excavation by the Contractor without prior approval shall be provided by the Contractor at no additional cost to the Owner.
- E. Payment for authorized over-excavation and subsequent backfill materials shall be on a unit price basis agreed between the Owner and the Contractor prior to the required work.
- F. All material which slides, fails, or caves into the established limits of excavations due to any cause whatsoever, shall be removed and disposed of at the Contractor's own expense and no extra compensation shall be paid the Contractor for any materials ordered for backfilling the void areas left by the slide, fall, or cave-in. It is the Contractor's responsibility to make all excavations safe for ongoing construction.
- 3.12 UNSTABLE SOILS REMOVAL METHODS (if required)
- A. Methods of Removal: Prior to the start of excavation operations, divert water away from work area and create dry conditions. Through the use of dragline, clamshell, or other necessary equipment, excavate and legally dispose of all unacceptable material.
- B. Precautionary Measures: Divert the run-off of mud and water during the course of removal of wet and unstable material to avoid adversely effecting adjacent construction or site improvement operations. Barricade, rope off, or otherwise protect workmen, active facility, and the public from open excavations, waterholes, and other hazards resulting from the work of this operation.
- C. Damage: The Contractor shall correct any damage to structures, foundations, site improvement work or adjacent property resulting from the work of this operation.
- D. Degree of Removal Required: Remove all unstable material to the point of sound stable earth or as directed by the Architect/Engineer.
- 3.13 ROCK EXCAVATION (if required)
- A. Degree of Removal required: Rock, if encountered shall be removed to depths (pay lines) as follows:
1. In Building Areas
 - a. 2-foot outside of concrete work for which forms are required, except footings.
 - b. 1-foot outside perimeter or concrete forms of footings.

- c. Outside dimensions of concrete work where no forms or exterior waterproofing treatments are required.
 - d. Under slabs on grade: to subgrade or 8-inches below bottom of concrete slab whichever is greater.
 2. Under Areas to Receive Pavement - To the surface of the respective subgrade for such areas. Boulders or isolated pockets of rock shall be removed to 12-inches below the pavement subgrade and the resultant excavation backfilled with pavement subbase-course material.
 3. Under Lawn and Planted Areas - To 24-inches below finished grade. Boulders or protruding rock outcropping where in the manner determined by the Architect/Engineer may be left undisturbed, provided a directive to this effect is transmitted to the Contractor.
 4. In pipe trenches for pipes 18-inch diameter and smaller: 6-inches below bottom of pipe and 2-feet wider than outside diameter of pipe, one (1) foot each side of pipe, but not less than 3-foot minimum trench width.
 5. In pipe trenches for pipes larger than 18-inch diameter refer to Contract Drawing details for additional rock removal requirements.
 6. In all other cases to 6-inches below subgrade.
 7. No payments will be made for excavation beyond pay lines.
- B. No blasting is allowed.
- C. The Contractor is responsible for measurement of rock material in place. (Also refer to Part 3 – Methods of Control of Excavation and Grading.)
- D. Payment for rock removal shall be on a unit price basis agreed between the Owner and the Contractor prior to rock removal.

3.14 EXCAVATION FOR STRUCTURES

- A. Excavations for structures and facilities shall be of sufficient size to give suitable room for proper construction procedures and no larger, or as shown on the Contract Drawings.
- B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections. Provide clearance sufficient for formwork. Banks and sides shall be at angle of repose or recline or sheathed, sheeted, shored and braced as required for safety, and conforming to all applicable laws, rules, regulations and codes. Remove shoring prior to backfilling.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades and remove loose materials and debris from excavation so that all footings rest on solid rock or approved undisturbed bearing soil, to leave solid base to receive other work.

2. If unsuitable bearing soil is encountered at depth indicated on Contract Drawings for foundation, the Contractor shall notify the Architect/Engineer and shall not proceed further until direction is given.
 3. Pile Foundations: Stop excavations 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
- C. Excavations at Edges of Tree- and Plant-Protection Zones:
1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Cut and protect roots according to requirements in Division 31 Section "Site Clearing", Part 3 -Tree and Plant Protection.
- D. Ensure that movement of equipment in excavation does not cause working or pumping of underlying soil, which is not to be excavated. Should equipment cause the soil to work or pump, use other methods of excavation to maintain the design bearing capacity of the soil.

3.15 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.16 EXCAVATION FOR UTILITY TRENCHES

A. General

1. Trenches shall be excavated as shown on the Contract Drawings.
 2. Before any trenching operation starts, the line of work shall be cleared and all existing underground pipe lines and structures located. Test pits shall be opened where necessary to properly establish the location.
 3. When trenches crossing other pipe lines occur, machine excavation shall stop at least 2 feet away from the location of any pipe. The pipe line shall then be uncovered by manual excavation before proceeding with machine work.
 4. Trenches shall be kept free of water by pumping or providing well points.
 5. Trench sheeting and bracing shall be placed as required to meet local, state and federal safety regulations.
 6. All pipe lines encountered during the trenching operation shall be properly supported to prevent damage.
- B. Excavate trenches to indicated gradients, lines, depths, and elevations.
- C. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches minimum each side of pipe or conduit or as indicated on the various utility trenching and bedding details on the Contract Drawings.

D. **Trench Bottoms:** (Where bedding course is not required.) Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course. Refer to Part 3 – Rock Excavation

E. **Trench Bottoms:** (Where bedding course is required [e.g. facility water main, storm and sanitary sewers; and, pipes or conduits constructed under footings or foundations])

1. For pipes and conduits 18-inches or smaller in nominal diameter, excavate trenches minimum of 6-inches deeper, than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
2. For pipes 21- to 36-inches in nominal diameter excavate trenches minimum of 9-inches deeper, than bottom of pipe and conduit elevations to allow for bedding course.
3. Excavate trenches in rock or other unyielding bearing material to depths indicated above depending on pipe or conduit size to allow for bedding course. Refer to Part 3 – Rock Excavation.

F. **Trenches in Tree- and Plant-Protection Zones:**

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Division 31 Section “Site Clearing”, Part 3-Tree and Plant Protection.

3.17 SUBGRADE INSPECTION

- A. Notify Owner’s Designated Representative when excavations have reached required subgrade.
- B. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 10 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Proof-rolling shall be witnessed by the Architect/Engineer or his designated representative.

2. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
 3. Excavate any loose, wet, frozen, or soft spots; unsatisfactory soils; and areas of excessive pumping or rutting, as determined by Architect/Engineer and replace with compacted backfill or fill as directed. Refer to Part 3- Excavations Below Subgrade.
 4. If subgrade ruts, waves or quakes during proof rolling, recompact or replace unacceptable area and proof roll again.
 5. Repeat process until suitable results are obtained as approved by the Architect/Engineer or his designated representative
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect/Engineer and/or Owner's Designated Representative, without additional compensation.

3.18 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. All stockpiled materials shall be stored in locations so as not to endanger the work, and so that easy access may be had at all times to all parts of the excavation. Stored materials shall be kept neatly piled and trimmed, so as to cause as little inconvenience as possible to other Contractors on site, to adjoining property owners and to the active facility.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
- B. Topsoil suitable for final grading shall be removed and stored on-site separately from other excavated material.
- C. Place, grade and shape stockpiles for proper drainage. Provide proper erosion control measures around stockpiles.

3.19 BACKFILL

- A. All excavations shall be backfilled to the original surface of the ground or to the lines and grades as shown on the Contract Drawings or as otherwise specified, or directed. Backfilling shall be done with suitable excavated materials as shown on the Contract Drawings or approved by the Architect/Engineer, and satisfactorily compacted.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. Place and compact backfill in excavations promptly, as work permits but not before completing the following:
1. Acceptance of construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Inspection, testing, approval, and recording of locations and inverts for underground utilities has been performed and documented.
 3. Removal of concrete formwork.

4. Removal of temporary shoring and bracing, and sheeting and backfilling of voids with satisfactory materials.
 5. Removal of trash and debris from excavation.
 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
- D. Excavated material considered by the Owner's Designated Representative or Architect/Engineer to be unsuitable for backfilling shall not be used, and shall be disposed in accordance with Part 3- Disposal of Excess and Waste Materials.

3.20 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill and compact trenches excavated under footings and within 18-inches of bottom of footings with 1000 psi CLSM to elevation of bottom of footings plus 3 inches.
 1. Backfill trenches with 1000 psi CLSM where trench excavations pass horizontally within 18-inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place CLSM to level of bottom of adjacent footing plus 3 inches.
- D. Backfill voids with satisfactory soil while removing shoring and bracing.
- E. Place and compact initial backfill as shown on details.
 1. For soil and granular initial backfill: Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
 2. For Controlled Low-Strength Material: Where CLSM indicated, place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
- F. Place and compact final backfill to final subgrade elevation.
- G. Install warning tape/detectable warning tape at elevations as shown on the Contract Drawings. Where not shown on the Contract Drawings install warning tape, centered and 12 inches above utility.
- H. All pipes shall be protected from lateral displacement and possible damage resulting from backfill operations through, impact or unbalanced loading, by maintaining the pipe adequately embedded as detailed on the Plans. Except where detailed or due to subsoil conditions that require the use of concrete cradle encasement, all pipe embedment shall be placed so as to insure adequate lateral

and vertical stability of the installed pipe during pipe jointing and backfill operations. A sufficient amount of the specified pipe backfill material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted below, on each side, as well as above each pipe laid in accordance with the limits as shown on the Contract Drawings.

- I. Pipe initial backfill shall be granular material or as indicated on the Contract Drawings. Pipe initial backfill materials placed any point below an elevation of 12 inches above the top of the pipe barrel shall be placed and compacted in layers not to exceed 6 inch lifts and shall be done simultaneously and uniformly on both sides of the pipe to the limits as shown on the Contract Drawings. All such materials shall be graded in the trench with hand tools in such a manner that they will be placed uniformly alongside the pipe. Each layer shall be thoroughly compacted to prevent settlement.
- J. Trench final backfill when placed under pavements, utilities, buildings and other structures shall be Engineered Fill, Subbase Material or as indicated on the Contract Drawings and shall extend from the top of pipe initial backfill material to the bottom of the subbase. These materials shall be compacted in layers not to exceed 6 inch lifts. Each layer shall be thoroughly compacted to prevent settlement.
- K. Trench final backfill outside of pavements, utilities, buildings, and other structures shall consist of common earth backfill or as otherwise shown on the Contract Drawings and shall extend from the top of pipe initial backfill material to the bottom of the topsoil. These backfill materials shall be compacted in layers not to exceed 12-inch lifts after compaction. Each layer shall be thoroughly compacted to prevent settlement.
- L. Where trenches are constructed in, near, or across roadway ditches or other watercourses, the backfill shall be protected from surface erosion.
- M. Trucks or other heavy equipment shall not be operated over pipelines until a minimum of 24 inches of backfill above the crown of the pipe has been placed and properly compacted.
- N. Where pedestrian, bicycle or vehicle traffic is impacted; all trenches within paved areas shall be immediately restored to existing grade with temporary subbase material to allow traffic flow to continue until final restoration is complete.
- O. Trench backfill for waterway crossings, if any, shall include 18 inches of medium stone fill rock lining meeting the requirements of this Section.
- P. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by the Architect/Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

3.21 BACKFILLING OR PLACING FILL AROUND STRUCTURES

- A. Location of Fill Types: (Where not otherwise shown on the Contract Drawings)

Type 1 (Select Earth Fill) - In all areas outside of building area to within 6" of finished grade, except at asphalt, concrete or brick pavements; curbing; concrete slabs; or graveled areas;

where it is to be brought to an elevation appropriate to allow all subbase, asphalt, concrete or brick materials to be placed to grade as shown on the Contract Drawings.

Type 2 (Engineered Fill) - In all fill areas within the building up to the subgrade limits.

Type 3 (Subbase NYSDOT 304-2, Type 2) – Subbase under slabs. Depth as indicated on the Contract Drawings.

- B. Backfilling around structures shall not be commenced until directed by the Owner's Designated Representative.
- C. Prior to backfilling, a minimum of seven (7) days cure time shall elapse from the placing of cast-in-place concrete. The Contractor shall comply with any special requirements noted on the Contract Drawings. In no case shall backfill materials be allowed to fall directly on a structure or to damage the structure or its protective coatings.
- D. Backfill around structures shall be deposited in horizontal layers not more than 6- to 8-inches in thickness and shall be compacted by tamping to prevent settlement. Backfill shall be no more than 4 inches thick when hand-operated equipment is used. Backfill shall be brought up evenly on all sides of structures so as not to subject the structure to unequal loadings. Do not backfill against unsupported walls or structures.
- E. Evenly distribute stones in fill, none over 3-inch diameter within top 12-inches of subgrade. Remove rocks and compact each layer of fill before applying next layer. Slope to prevent ponding of water and to provide positive drainage away from building(s) and roadways. Dewater as required to prevent water from setting in excavated and graded areas. No backfilling will be allowed in areas full of water.
- F. At all times the Contractor shall maintain and operate proper and adequate surface and subsurface drainage methods to the satisfaction of the Owner's Designated Representative in order to keep the construction site dry and in such condition that placement and compaction of fill may proceed unhindered by saturation of the area. During construction, the surface of the fill area shall be left in such condition that precipitation and/or surface water will run off.
- G. Place underslab base material (Type 3 Fill as noted above) after all underslab mechanical lines, electrical conduits, etc. have been installed. Protect lines, etc. as required.
- H. When a compacted course is indicated to be 6" thick or less, place material in a single layer. When indicated to be more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted

3.22 EMBANKMENT CONSTRUCTION (if required)

- A. Prior to the placement of materials in fill sections, remove all debris and other deleterious material and stabilize all existing surfaces.
- B. Ground surfaces sloped steeper than 1 vertical on 4 horizontal shall be plowed, scarified, stepped, or broken up to permit bonding of the embankment with the existing surface.

- C. Prior to placement of fill, the embankment foundation shall be thoroughly inspected by the Architect/Engineer. The embankment foundation shall be proof rolled by a roller or loaded ten wheeler (not less than 10-tons) to the satisfaction of the Architect/Engineer. Proofrolling shall be witnessed by the Architect/Engineer or his designated representative. Any loose, soft, wet, frozen, organic, or otherwise unsuitable material shall be removed and replaced with Engineered Fill. If embankment foundation ruts, waves or quakes during proof rolling, recompact or replace unacceptable area and proof roll again. Repeat process until suitable results are obtained as approved by the Architect/Engineer or his designated representative.
- D. Uniformly place and spread fill in successive horizontal layers not more than 8-inches in compacted depth for material compacted by heavy compaction equipment, and not more than 4-inches in loose depth for materials compacted by hand operated tampers. Complete compaction to proper density and complete compaction testing prior to placing additional backfill material.
- E. The embankment shall be constructed with suitable on-site materials amended as needed to meet application. When on-site material supplies are exhausted, additional suitable imported material shall be used to complete the embankment. The Architect/Engineer shall be the sole judge of what constitutes suitable and unsuitable material.

3.23 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 85 percent of maximum ~~dry unit weight~~ density with a minimum of two passes of a plate-type vibratory compactor.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 85 percent of maximum ~~dry unit weight~~ density with a minimum of two passes of a plate-type vibratory compactor.
 - 2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.24 PREPARATION OF PAVEMENT SUBGRADES

- A. Shape the entire subgrade to the required line, grade, and cross slope. Remove any protruding stones larger in diameter than 5 inches and fill the resulting depressions with Subbase Material.
- B. Proof-roll the subgrade in accordance with Part 3 Subgrade Inspection. Proofrolling shall be witnessed by the Architect/Engineer or his designated representative. Any loose, soft, wet, frozen, organic, or otherwise unsuitable material shall be removed and replaced with Engineered Fill. If subgrade surface ruts, waves or quakes during proof rolling, recompact or replace unacceptable area

and proof roll again. Repeat process until suitable results are obtained as approved by the Architect/Engineer or his designated representative.

- C. Roll the subgrade surface with a roller weighing not less than 10 tons and achieve the required compaction densities. If during construction, the Contractor allows the subgrade to become wet and rutted, Contractor shall re-shape, aerate, and recompact subgrade, as required. Compact the entire width of the area to receive pavement and shoulders. Where subgrade failures occur due to rolling, thoroughly roll and compact these areas until no further consolidation is apparent.
- D. When pavements cannot be placed immediately after the preparation of the subgrade, the entire, subgrade area shall be restricted to construction traffic until subbase materials can be placed.
- E. After rolling, the finished subgrade shall not vary from the established grade and cross slope by more than the tolerance indicated in Part 3-Grading.
- F. Do not disturb the finished subgrade by traffic or other operations and protect and maintain in a satisfactory condition until the overlaying granular materials are placed.
- G. Any deteriorated subgrade areas that occur during construction are to be removed and repaired by Contractor prior to placement of subbase at no additional cost to Owner.

3.25 STABILIZATION FABRIC (if required)

- A. The stabilization fabric shall be placed over subgrade only after the subgrade has been reviewed and limits for fabric established by the Architect/Engineer.
- B. The fabric shall be unrolled over the designated subgrade area with a 24-inch overlap at fabric ends and allowing 18-inch overlap on sides. Prior to placement of subbase materials the fabric shall be pulled tight leaving no waves in the fabric.
- C. Subbase materials shall be placed on the fabric in such a manner that equipment does not come in contact with the fabric, the fabric remains in tension and no damage to the filter cloth from equipment or subbase materials occurs. All fabric placed shall be covered with fill the same day.
- D. Fabric, which becomes damaged prior to covering, shall be removed over its full width and replaced with new fabric, overlapping as stated above.
- E. Maintain a minimum of 8 inches loose thickness of aggregate above stabilization fabric subject to traffic.

3.26 SUBBASE COURSES UNDER PAVEMENTS AND WALKS

- A. The Contractor shall notify the Architect/Engineer at least three days before any subbase material is scheduled to be placed.
- B. Place subbase course on subgrades free of mud, frost, snow, or ice.
- C. Subbase shall be placed to the thickness and limits as shown on the Contract Drawings.

- D. On prepared subgrade, place subbase course under pavements and walks as follows:
1. Install separation or stabilization geotextile (where required) on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Shape subbase course to required crown elevations and cross-slope grades.
 3. Place subbase course 6 inches or less in compacted thickness in a single layer.
 4. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 5. Each course shall be compacted with a vibratory compactor capable of producing a minimum dynamic vibration force of 27,000 pounds.
 6. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness. Meet compaction requirements in accordance with this specification.
- E. Compaction for driveways or roadways shall proceed in the longitudinal direction to traffic flow and be performed in accordance with NYSS Section 304. Compaction for parking areas shall commence on one side of an area and gradually proceed to the opposite side. When rolling has been completed in one direction, the rolling shall commence in a direction 90 degrees from the first rolling. Bus loops, if any shall be considered as a driveway and shall only be rolled longitudinally.
- F. After completion of rolling, no traffic shall be permitted over the compacted course and no hauling other than necessary for bringing material for next course will be allowed. Each compacted course shall be tested with a straight edge 16 feet in length and any depressions greater than 1/4 inch in depth shall be re-graded until the depressions are corrected. The finished surface shall be smooth compact and dry.
- G. All voids in the top subbase course shall be removed by re-grading and compacting to the satisfaction of the Architect/Engineer.
- H. Thickness tests and compaction tests shall be conducted on the subbase courses. The Contractor shall hand dig holes, not less than 3" in diameter through the subbase, at locations designated by the Architect/Engineer. The Architect/Engineer shall measure the thickness and if any deficiencies are found, they shall be corrected. These tests may be conducted on an average of one test every 200 feet.

3.27 DRAINAGE COURSE UNDER CONCRETE BUILDING SLABS-ON-GRADE

- A. Place subbase course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade as indicated, according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum density according to ASTM D 1557.
5. Place vapor barrier Specified in Division 03 Section "Cast-in-Place Concrete".

3.28 COMPACTION OF SOIL (EARTH & GRANULAR) BACKFILLS AND FILLS

A. Performance:

1. Compaction densities shown are percentages of the maximum density obtainable at optimum moisture content as determined by ASTM D1557, Method C.
2. Uniformly spread each layer. Moisten or dry each layer of material to achieve optimum moisture content. Unless otherwise specified or directed by Architect/Engineer, compact each layer of material to the following required densities:

Location	Percentage of Modified Proctor Test Density
Under concrete slab, foundations, and footings	95%*
Backfill at Structures	95%
Undercut Backfill	95%
General Fill adjacent to and outside of Buildings	93%
Structural Engineered Fill at Bldgs	95%
Embankments	95%
Pavement Areas (asphalt and concrete and brick)	95%
Impervious Barriers	95%
Trench Backfill	
Under Traffic Areas (Including side-walks)	95%
Non-Traffic areas	90%
Other Landscaped Areas	90%
*100% for granular material if specified	

- B. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

3.29 FIELD QUALITY CONTROL AND TESTING

- A. Contractor shall provide free access to Work and shall provide assistance and cooperation with appointed testing firm during testing. Coordinate operations to allow ample time for the required sampling and testing.
- B. Soil density and optimum moisture content tests for each source of imported material shall be conducted by the Contractor's independent, Architect/Engineer approved laboratory and shall be re-tested upon each significant change of material. Costs shall be included in the price bid.
- C. Samples from each source of material shall be made available to the Architect/Engineer for approval and testing purposes one week prior to its use.
- D. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- E. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during soils and granular material placement. Field density and moisture testing shall conform to the requirements of ASTM D1556 (sand core) or D2922 and ASTM D3017 (nuclear density). Soils shall be described in accordance with ASTM D2488, Visual-Manual Procedure.
- F. The following tests **will** be performed:
1. Perform a laboratory maximum density test for each type of **on-site** soil proposed for use or encountered in the work. Determine optimum moisture content in accordance with ASTM D1557, Method C.
- G. The following tests **may** be performed:
1. Perform a laboratory maximum density test for each type of Contractor imported soil or granular material proposed for use to verify Contractor submitted information. Determine optimum moisture content in accordance with ASTM D1557, Method C.
- H. Architect/Engineer will designate the time, date, and exact location of all field compaction density tests. Field density tests may be ordered by the Architect/Engineer at his discretion and at a minimum in accordance with the following average frequencies per lift:
1. General: One test for each type of fill and at each change in material or supplier.
 2. Backfill for Foundations, Retaining Walls and Utility Trenches: At least one test for each layer of compacted fill and base material at intervals of approximately 50 feet along structure walls (foundation or retaining) and utility trench backfill on alternating lifts.
 3. Embankments, Pavement Areas (asphalt, concrete, brick): At least one test on each 2,000 sq. ft. or less of mass fill placed under roadways, pavements (asphalt, stone or concrete) and sidewalks but not less than three tests for each partial lift.
 4. Under Structures, Foundations, Slabs, Retaining Walls and Footings: At least one test on each 2,000 sq. ft. or less of mass fill placed under structures, foundations, floor slabs, retaining walls and footings with at least three tests for each partial lift.
 5. Under Building Pads: Perform at least one test of subgrade for every 2,000 sq. ft. of building pad, but in no case fewer than three tests of subgrade. In addition, for each layer of

compacted fill or backfill, if any, perform one field test for every 1,000 sq. ft. of overlaying building slab, but in no case fewer than three tests per lift. Compaction tests for areas under building slabs shall be completed not more than 24-hours prior to placement of concrete.

6. Landscaped Areas: One test per 300 cubic yards of compacted fill or backfill but not less than two per lift.
 - I. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.
 - J. Compacted soils not meeting compaction densities shall be re-excavated, re-compacted, and re-tested until all requirements are met. All costs of re-testing shall be borne by the Contractor.
 - K. Materials not meeting gradation requirements shall be removed from the project site and replaced with appropriate materials. All costs of re-testing shall be borne by the Contractor.
 - L. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect/Engineer.
- 3.30 DISPOSAL OF EXCESS AND WASTE MATERIALS
- A. Remove waste materials, including unacceptable/unsuitable excavated material, trash, and debris, and legally dispose off-site.
 - B. Remove excess excavated material and other materials not specified to be stored, or reused. Dispose off-site at a disposal site approved for the materials.
 - C. Burning or burial of excess or waste materials at the site is not permitted. Such materials shall be disposed of off-site in conformance with applicable local, state and federal legal requirements.
 - D. Excess excavated materials may temporarily be stockpiled on-site at a location approved by the Architect/Engineer,-OR Owner's Designated Representative.
 - E. All costs related to stockpiling, rehandling, transporting, removing and disposal of excess (including suitable and unsuitable) and waste materials shall be paid by the Contractor. Costs shall be included in the price bid.
 - F. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread and rough grade soil as directed by Owner's Designated Representative or the Architect/Engineer. Provide erosion control measures.
 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off-site.

3.31 MAINTENANCE AND PROTECTION OF WORK

- A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Protect subgrades and foundation soils from freezing temperatures and frosts when atmospheric temperature is lower than 35 degrees F.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Owner's Designated Representative; reshape and recompact.
- C. Settling: Where settling is measurable or observable at excavated areas during construction, remove finished surface (pavement, lawn, or other finish areas), add backfill material, compact, and replace/reconstruct surface treatment.
 - 1. Restore appearance, quality, and condition of finished surface to match adjacent work, and eliminate evidence of restoration to greatest extent possible, at the Contractor's expense.
- D. Any backfill or fill materials that settle and/or erode during the general project warranty period shall be repaired by the Contractor upon receipt of written notice from the Owner's Designated Representative, at no expense to the Owner.
 - 1. Remove finished surface (pavement, lawn, or other finish areas), add backfill material, compact, and replace/reconstruct surface treatment.
 - 2. Restore appearance, quality, and condition of finished surface to match adjacent work, and eliminate evidence of restoration to greatest extent possible, at the Contractor's expense.
- E. Replace or repair any pipe, structure, or other work, which has been displaced or damaged during construction and general project warranty period at no expense to Owner.
- F. Repair to proper grade any settlement of slab, pavement, utility structure, lawn, etc. adversely affected by settlement within general project warranty period at no expense to Owner.

END OF SECTION 312000

SECTION 321216 - ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work of this Section includes, but is not limited to:
1. Aggregates
 2. Hot Mix Asphalt Concrete
 3. Liquid Asphalts
- B. Deliver all container materials in manufacturer's standard, unopened containers with labels legible and intact. Store and protect from damage, freezing, or sunlight and heat, if required of individual product.
- C. Store all materials and other items where damage and/or contamination will not occur.
- D. Related Sections:
1. Division 31 Section **“Earth Moving”**

1.3 DEFINITIONS

- A. Pavement Area: The full width of hard bituminous road, parking surfaces, and asphalt sidewalks as shown on the Drawings.
- B. NYSDOT: New York State Department of Transportation
- C. NYSS or NYSDOT Specification Section: New York State Department of Transportation Standard Specifications dated May 1, 2008 (and any subsequent revisions).

1.4 QUALITY ASSURANCE

- A. Provide at least one person who shall be present at all times during the execution of this portion of the work, and who shall be thoroughly qualified and experienced in the placing of the type of pavements specified and who shall direct all work performed under this section.
- B. Comply with the referenced portions of NYSS.
- C. All testing shall be performed by an approved testing laboratory. The Architect/Engineer may use the testing laboratory for inspection services.

- D. Use only the materials and job-mix formula approved by the Architect/Engineer. Failure to consistently meet the approved job-mix formula shall be sufficient cause for the Architect/Engineer to prohibit the use of the asphalt supplier.
- E. All finished paved surfaces shall be smooth, even, and free from surface defects and irregularities. Edges shall be straight, and shall meet existing pavements smoothly. Pavement shall present a smooth, continuous, and workmanlike appearance, free from patchwork, rough edges, spalling areas, potholes, depressions, bumps, and other defects. The finished installation shall meet with the complete approval of the Architect/Engineer and Owner with respect to appearance as well as structural integrity and other criteria.
- F. Bituminous materials shall not be placed on any soft grade, when the grade is wet, when the temperature of the surface on which the mixture is to be placed is below 45°F (below 50°F for 1-inch compacted thickness or less), above 95°F, or when other weather conditions would prevent proper handling or finishing of asphalt mixtures unless otherwise ordered or approved by the Architect/Engineer.

1.5 SOURCE QUALITY CONTROL

- A. The asphalt plant shall be approved by the Architect/Engineer.
- B. All materials and the asphalt plant will be subject to inspections and tests by the Architect/Engineer and by the approved testing laboratory.
- C. Submit sieve analysis of each subbase material from each granular material source.
- D. Submit mill analysis of each grade of asphalt from each material source.

1.6 JOB-MIX FORMULA

- A. No paving shall commence until a job-mix formula for each asphalt material to be placed has been submitted to and approved by the Architect/Engineer. The required job-mix formula shall be prepared by an approved testing laboratory and shall comply with the NYSS. Provide all testing as required to clearly show that materials meet specification requirements.
- B. If a previously established job-mix formula is proposed, certified copies of the mix formula and all test reports made within the last six months by a recognized testing laboratory may be submitted. If the formula and test results comply with these specifications and sufficient evidence of compliance is submitted and is acceptable to the Architect/Engineer, a new job-mix formula will not be required. If insufficient data exists, the Architect/Engineer may request additional testing, or he may require a new job-mix formula.

1.7 SUBMITTALS

- A. Proposed job-mix formula and certified materials tests as required under Part 1 – Job Formula shall be submitted.
- B. Name, address and telephone number of the asphalt plant proposed for use and a certification that the proposed source conforms to the requirements of these specifications shall be submitted.
- C. Evidence shall be submitted indicating that all materials meet the necessary requirements as specified herein.
- D. Source quality control information as required in Part 1- Source Quality Control.
- E. Certified test reports on tests required under Part 3 of this specification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Hauling equipment shall conform to NYSS. The Contractor is advised that length of haul, manner of haul, temperature of asphalt, and similar criteria, have a direct bearing on the quality and acceptability of the finished pavements. These other criteria shall be properly controlled such that the job mix of asphalt, when placed, is identical to that specified, approved, and as it left the asphalt plant. Segregation of aggregates, whether occasioned by hauling operations, improper mixing at the asphalt plant, or for other reasons, will result in rejection of the pavement. Clusters and pockets of aggregate in the finished pavement surface, with voids surrounding the aggregates, are unacceptable and will be rejected.
- B. All asphalt job mixes shall be delivered to the site and incorporated into the work within the mixing and placing temperature ranges as listed in the NYSS.
- C. Subbase granular materials shall be hauled, placed, and graded in a manner to assure good drainage, to preclude the inclusion of foreign matter and to preserve the gradation.
- D. Deliver all container materials in manufacturer's standard, unopened containers with labels legible and intact. Store and protect from damage, freezing, or sunlight and heat, if required of individual product.
- E. Store all materials and other items where damage and/or contamination will not occur.

1.9 JOB CONDITIONS

- A. Asphalt top course shall be placed only during the periods of May 1st up to and including the third Saturday of October when the temperature and conditions are as specified in Part 1- Quality Assurance. Deviations from this time schedule shall be only as approved by the Architect/Engineer.
- B. Asphalt concrete pavement shall be installed upon previous courses, which are clean, dry, and free from standing water, and only when weather conditions are suitable.

- C. Defective Pavement: Portions of the completed pavement which are defective in finish, compaction or elevation, or that do not comply in all respects with the requirements of the contract documents, shall be taken up, removed and replaced with suitable material, and properly installed in accordance with the contract documents.
- D. Environmental Conditions:
 - 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Binder Course: Minimum surface temperature of 45 deg F and rising at time of placement.
 - 3. Asphalt Top Course: As indicated in Part 1 – Job Conditions and Quality Assurance
- E. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 – PRODUCTS

2.1 STONE SUBBASE COURSE

- A. The subbase course materials shall consist of granular materials as shown on the Contract Drawings and/or as specified in Division 31 Section “Earth Moving”. Depth as shown on the Contract Drawings.

2.2 BITUMINOUS PAVEMENT

- A. Bituminous pavement shall be constructed with approved materials as stipulated in NYSS, Section 400. Job-mix formulas shall be formulated and submitted by the Contractor within the general limits imposed by NYSS Section 402.
- B. A binder course shall be placed at a thickness as to produce a required completed thickness when well compacted with a ten (10) ton roller. The material shall be installed at the required completed thickness as shown on the Contract Drawings.
- C. A wearing course shall be constructed on top of the binder course and shall produce the required completed thickness when well compacted with a ten (10) ton roller. The material shall be NYSDOT Type 12.5 F2 Top Course HMA. Required completed thickness shall be as shown on the Contract Drawings.
- D. Base course (where required) shall be placed at a thickness as to produce the required completed thickness when well compacted with a ten (10) ton roller. Base course shall be Type 37.5 F9 Base Course HMA, in accordance with NYSS Section 402. Required completed thickness shall be as shown on the Contract Drawings.
- E. In milled areas, an Asphalt Truing and Leveling course shall be placed on top of the milled surface prior to overlay course. The material shall be NYSDOT Asphalt Truing and Leveling Course. Truing and Leveling Course will not be included in the measurement of completed asphalt thickness.

- F. Asphalt tack coat shall conform to NYSS material designation 702-90.
- G. Bituminous sealer shall conform to NYSS material designations 702-05 or 702-3401.
- H. Bituminous Joint and Crack Filler shall conform with requirements of NYSS material designations 702-0700

2.3 ASPHALT SIDEWALK

- A. All materials shall be as used for bituminous paving except that they shall be placed to the thickness as shown on the contract drawings.
- B. All other materials shall be as used for bituminous paving.

2.4 MIXES

- A. All bituminous concrete shall be mixed at the approved asphalt mixing plant in accordance with NYSS.

2.5 PAVEMENT STABILIZATION GEOTEXTILE FABRIC

- A. The pavement stabilization geotextile materials shall be in accordance with Division 31 Section "Earth Moving".

2.6 PAVEMENT MARKING PAINT

- A. Pavement marking paints for roadway centerline, bus loop and crosswalks shall conform to standards for reflectorized roadway striping. Epoxy reflectorized pavement striping is not required. Markings shall be yellow or white as indicated on the drawings.
- B. Glass beads for use in reflectorized pavement marking paints shall conform to NYS DOT Specification 727-05.
- C. Pavement striping for parking and lettering shall conform to roadway striping except that no glass beads are required. Markings for lettering shall be white in color. Marking for parking shall be yellow in color.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to the work of this section, verify that all utility, piping and grading work is complete, tested and approved by the Architect/Engineer and to the point where pavement installation may be properly performed. Particular attention is given to items such as pipelines or conduits so as to avoid excavating pavements at a later date.

- B. Joints, where required, due to the discontinuation of work, shall be well bonded and sealed in such a manner as to create an integral appearance. Joints in successive courses shall be offset a minimum of two (2) feet horizontally from the lower pavement course. Transverse and longitudinal joints shall be performed in accordance with NYSS Section 401. Care shall be taken by workmen at all times to avoid walking on freshly spread material.
- C. Where, curbs, pavers, concrete sidewalk, manholes or other objects come in contact with the pavement, they shall receive a uniform coating of an asphalt tack coat. The asphalt coating shall be applied according to the manufacturer's recommendations but in no case shall it be applied above the elevation of the abutting asphalt materials.
- D. All asphalt material shall be placed in a uniform layer by an approved bituminous paver. Hand placement may be permitted in small irregularly shaped areas, which are not accessible to a paver, only with prior Architect/Engineer approval.
- E. Each days paving (base, binder or top) shall begin from a straight saw cut joint approved by the Architect/Engineer.
- F. Joints at existing pavements shall be vertically sawcut. Apply tack coat on surfaces as shown on joint detail of Contract Drawings before beginning placement of new material. New material surfaces shall match existing surface.
- G. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.
- H. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- I. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- J. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- K. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.2 SUBGRADE PREPARATION

- A. Subgrade shall be prepared in accordance with Division 31 Section "Earth Moving".
- B. The Architect/Engineer may require a field demonstration of compaction equipment before approving subgrade. Rolling and compacting shall be done in the longitudinal direction of the traffic flow. If the moisture content of the soil is outside of the limits required to achieve the required compaction in accordance with Division 31 Section "Earth Moving", the Architect/Engineer will require the addition of water or discing and re-grading so that the required degree of compaction

shall be achieved. Obtain Architect/Engineer's approval of subgrade prior to placing subbase course or geotextile fabric (if fabric is required).

3.3 STABILIZATION FABRIC

- A. Geotextile shall be installed in accordance with Division 31 Section "Earth Moving".

3.4 SUBBASE COURSE INSTALLATION

- A. Subbase course shall be prepared in accordance with Division 31 Section "Earth Moving".

3.5 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 BASE COURSE INSTALLATION (if required)

- A. Asphalt concrete base course, as required by the Contract Documents, shall be placed to thickness and limits as shown on the Contract Drawings and only upon an Architect/Engineer approved subbase grade.
- B. Compact the base course as specified in NYSS Section 402. In areas where rollers are inaccessible, compaction shall be effected with hand tampers or gas-fired compactors weighing not less than 25 pounds and having a bearing area not greater than 48 square inches.
- C. Care shall be taken when rolling adjacent to a curb, sidewalk, light pole or other structure. Damage to any structure shall be repaired or replaced by the Contractor as ordered by the Architect/Engineer at no additional cost to the Owner.
- D. The surface shall be tested with a 16-foot straight edge and all variations exceeding 1/4 inch in height or depth shall be eliminated.

3.7 BINDER COURSE INSTALLATION

- A. Asphalt binder shall be placed to the thickness and limits as shown on the Contract Drawings and only upon an Architect/Engineer approved subbase grade (where no base course) or approved base course.
- B. The roadway or sidewalk base surface to be covered shall be free from holes, depressions, bumps, waves, and corrugations. Any unsuitable surface areas or where directed by the Architect/Engineer shall be repaired by replacement of the unstable materials or by patching with a material to produce a

tight surface having the correct grade. The roadway surface shall be cleaned by the use of mechanical sweepers, hand brooms, or other effective means until the surfaces are free of all material, which might interfere with the bond between the overlay material and the existing surfaces.

All cleaning equipment shall be approved by the Architect/Engineer prior to use. Cleaning shall continue until adequate cleaning results as determined by the Architect/Engineer. Cleaning shall be done immediately prior to overlaying at no additional cost to the Owner.

- C. Compact the binder course as specified in NYSS Section 402. In areas where rollers are inaccessible, compaction shall be effected with hand tampers or gas-fired compactors weighing not less than 25 pounds and having a bearing area not greater than 48 square inches.
- D. Care shall be taken when rolling adjacent to a curb, sidewalk, light pole or other structure. Damage to any structure shall be repaired or replaced by the Contractor as ordered by the Architect/Engineer at no additional cost to the Owner.
- E. The surface shall be tested with a 16-foot straight edge and all variations exceeding 1/4 inch in height or depth shall be eliminated.

3.8 TOP COURSE INSTALLATION

- A. Asphalt top course shall be placed only during the periods indicated in Part 1 Job Conditions.
- B. The roadway or sidewalk binder surface to be covered shall be free from holes, depressions, bumps, waves, and corrugations. Any unsuitable surface areas or where directed by the Architect/Engineer shall be repaired by replacement of the unstable materials or by patching with a material to produce a tight surface having the correct grade. The roadway surface shall be cleaned by the use of mechanical sweepers, hand brooms, or other effective means until the surfaces are free of all material, which might interfere with the bond between the overlay material and the existing surfaces. All cleaning equipment shall be approved by the Architect/Engineer prior to use. Cleaning shall continue until adequate cleaning results as determined by the Architect/Engineer. Cleaning shall be done immediately prior to overlaying at no additional cost to the Owner.
- C. The Contractor shall coordinate the application of the upper courses for new and existing asphaltic pavements so that the finished surface of both top courses will be uniformly level. Any irregularities or depressions in the existing pavement shall be corrected by placing additional asphaltic concrete.
- D. Roll the asphalt top course with a minimum ten ton roller, or as specified by the NYSS.
- E. The finished pavement shall present a continuous and even appearance from edge of pavement to edge of pavement. The top course shall be blended in to meet existing pavements where applicable.
- F. The surface shall be tested with a 16-foot straight edge and all variations exceeding 1/4 inch in height or depth shall be eliminated.

3.9 MANHOLE CASTINGS AND OTHER APPURTENANCES

- A. Manhole frames and covers, valve boxes, cleanout covers, catch basin frames and grates and dry well frames and grates shall be set so that the finished asphalt top course is 1/4 inch above each. In no

case shall these frames and covers, boxes or grates protrude above the finish pavement surface. Likewise these appurtenances shall not sit in depressions nor be paved over. Prior to completion of finished pavement, all castings and appurtenances shall be protected from damage by the Contractor.

3.10 PAVEMENT MARKINGS

- A. The Contractor shall paint solid markings using two coats of paint in those areas indicated on the contract drawings and as, hereinafter, specified. Markings shall be painted immediately after all aspects of the paving operations have been completed and before dirt can accumulate on the pavement surface.
- B. Protection: Install adequate barricades at points where trespassing can occur immediately after paving is completed so as to prevent vehicles or pedestrians from impeding the painting, operation.
- C. Method: Carefully layout and define all painted markings on the surface of the pavement by means of chalk markings before painting, and accurately paint all markings within the limits and to the dimensions indicated on the contract drawings. All surfaces must be thoroughly cleaned before markings are painted.

All markings shall be clear and distinct with sharply defined edges. Apply two coats of paint. At least 24 hours shall elapse between the painting of the first and second coats.

- D. Removal of Equipment: Upon completion of the painting operation and once the paint has dried, remove all barricades and other debris, which has resulted from this operation.
- E. Cleanup: Remove all spilled paint, tracking marks and unauthorized markings.

3.11 WEATHER AND SEASONAL LIMITATIONS

- A. Contractor shall schedule paving operations such that all paving necessary to provide safe and adequate maintenance and protection of traffic or for the protection of previously laid course is completed within the weather and seasonal limitation described previously.
- B. Scheduling and sequencing of work to conform to seasonal limitations shall be reflected in the price bid.
- C. If paving operations are not completed within the weather and seasonal limitations, all temporary materials and work needed (e.g. shimming of castings and protrusions, adequate drainage etc.) to provide acceptable ride-ability, and maintenance and protection of traffic shall be provided by the Contractor until paving operations can be completed at no additional cost to the Owner.
- D. Base or binder course, placed by the Contractor, which will be permanently incorporated into the work and left open to traffic over the winter, shall be cleaned and tack coated in accordance with NYSS. Cleaning and tack coat shall be done immediately prior to overlaying at no additional cost to the Owner.
- E. If the Contractor requests a waiver of the seasonal limitations and the Architect/Engineer determines it to be in the best interest of the Owner, the seasonal limitations may be waived for a limited period of time subject to temperature, time, weather and other conditions. Conditions of seasonal waiver

shall include, but not be limited to, withholding of payment for work performed beyond the seasonal limitation date pending determination of the pavement condition and performance during the following spring; and, delaying start of one-year warranty period.

- F. Contractor shall have no claim against the Owner for any costs attributable to disapproval of a waiver request. Architect/Engineer decision for approval or disapproval is final.
- G. Any pavement damage which occurs as a result of Contractor either not protecting previously laid course or constructing any pavement course outside weather or seasonal limits whether a waiver was granted or not, shall be repaired or replaced as determined by the Architect/Engineer at no additional cost to the Owner. All repairs or replacements shall be completed to the satisfaction of the Architect/Engineer and in accordance with these specifications.

3.12 PATCHING

- B. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate subbase course to form new subgrade.
- C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd. .
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Patching: Partially fill excavated pavements with hot-mix asphalt binder mix and, while still hot, compact. Cover asphalt binder course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.13 WARRANTY

- A. Settlement: Any settlement exceeding 1/8-inch in 10 feet horizontally or 1/4-inch total depression, which occurs in any asphalt work within one year after final acceptance, shall be entirely removed and brought to proper grade and repaired, to the satisfaction of the Architect/Engineer.
- B. If ponding or negative drainage patterns occur during within one year after final acceptance, the area shall be repaired to the satisfaction of the Architect/Engineer at no additional cost to the Owner.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVEMENT, SIDEWALKS AND CURBING

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. Extent of concrete pavement work includes, but is not limited to furnishing and placing complete the following:
 - 1. 5-inch depth concrete sidewalk.
 - 2. Place pre-molded bituminous joint filler to complete the concrete sidewalk and pavements
- B. Work for other cast-in-place slabs shall be completed in accordance with Division 03 Section "Cast in Place Concrete.
- C. Related Sections:
 - 1. Division 03 Section "**Cast-in-Place Concrete**"
 - 2. Division 31 Section "**Earth Moving**"

1.3 QUALITY ASSURANCE

- A. Concrete shall be tested in accordance with Part 3 - Quality Control Testing During Construction, of this specification. Materials and Testing Laboratory services shall be paid by the Owner for testing concrete cylinders for compressive strength. All concrete not meeting the proper requirements shall be removed from the site by the Contractor. Additional testing as required in accordance with Part 3 shall be the responsibility of the Contractor.
- B. All materials and work to prepare, form, place, finish, test, seal and cure the concrete sidewalk shall be completed in accordance with NYSDOT Specification Section 608 and as shown on the Contract Plans.
- C. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
 - 1. ACI 301, "Specification for Structural Concrete".
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.4 SUBMITTALS

- A. Submit proposed concrete mix design and laboratory test reports on mix design.
- B. Submit manufacturer's catalog cuts, technical data, and recommendations on quantities, installation, and application for the following:
 - 1. Formwork accessories.
 - 2. Concrete admixtures.
 - 3. Grout and patching materials.
 - 4. Bonding agents.
 - 5. Joint fillers and joint filler strips
 - 6. Curing and sealing compounds
- C. Submit concrete placement schedule prior to start of any concrete placement operations. Include location of all joints indicated on drawings, plus anticipated construction joints.
- D. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement and support of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

1.5 DELIVERY, HANDLING, STORAGE

- A. Deliver all container materials in manufacturer's standard, unopened containers with labels legible and intact. Store and protect from damage, freezing, or sunlight and heat, if required of individual product.
- B. Store all aggregates and other items where damage and/or contamination will not occur.
- C. Deliver, store and handle steel reinforcement to prevent bending and damage.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for: other construction activities; access to Campus facilities; and, safety for workers, Campus employees and general public.

PART 2 – PRODUCTS

2.1 SUBBASE

- A. The subbase course materials shall consist of granular materials as shown on the Contract Drawings and/or as specified in Division 31 Section "Earth Moving". Depth as shown on the Contract Drawings.

2.2 CONCRETE FOR PAVEMENT, SIDEWALKS AND SIDEWALKS WITH INTEGRAL CURB

- A. Readymix concrete conforming to ASTM C94 and this specification will be approved if obtained from an established contractor.
- B. All concrete shall have minimum 28-day strength of 4,500 psi, conforming to ASTM C94.
Concrete shall have:
- a. Water/Cement Ratio by wt. 0.48
 - b. Slump 3 ± 1 inches
 - c. Air Content $6.0 \pm 1\%$
- 1. Normal Portland Cement: Standard brand ASTM C-150, Type I.
 - 2. Sand: Shall be clean, sharp, natural sand, conforming to ASTM C-33-67. Material finer than #200 sieve shall not exceed 3 percent. Sand shall conform to NYSDOT Table 703-07 size designation.
 - 3. Aggregate: Shall be clean, strong, crushed limestone or natural washed gravel conforming to NYSDOT #1 (Table 703-4) as follows:

Sieve Size Designation	Percent Passing By Weight
1 inch	100%
1/2 inch	90 - 100%
1/4	0 - 15%
 - 4. Air-Entraining Admixture for Exposed Above Grade Concrete: Shall conform to ASTM C-260-69 "Specifications for Air-Entraining Admixtures for Concrete", "Class 1 Daxex AEA," or approved equal.
 - 5. High Range, Water-Reducing Admixture: ASTM C494, Type F
 - 6. Water-Reducing and Retarding Admixture: ASTM C494, Type A
 - 7. Water: Water for concrete shall comply with NYS Department of Health Standards for drinking water.
- C. Concrete Accessories:
- 1. Surface Sealant: Shall be a transparent, non-yellowing, waterborne, membrane-forming sealing compound meeting ASTM 1315, Type 1, Class A sealer for exterior use, such as Kure-N-Seal W by Sonneborn or other as approved by Architect/Engineer.
 - 2. Expansion Joint Filler (horizontal and vertical): Use in conjunction with "Zip-strip" preformed recess strips. Filler shall be a non-impregnated cane fiber-preformed of thickness shown on Contract drawings (Closed cell, semi-rigid foam is an acceptable alternate).
 - 3. Expansion Joint Sealer: Shall be a pour grade one-part, self-leveling polyurethane sealant, such as Sonneborn Sonolastic SL1. Light gray in color. Use compatible primer where suggested by manufacturer.
 - 4. Welded Wire Mesh: Shall be 6 inches x 6 inches, cold drawn 6-gauge wire conforming to ASTM A-185-69. Mesh shall be supplied in flat sheets. Provide 2 layers offset where indicated on the contract drawings.
 - 5. Reinforcing Bars: ANSI/ASTM A-615, Grade 60, deformed.
 - 6. Supports: Provide supports for reinforcement (welded wire mesh & reinforcing bars) including bolsters, chairs, spacers and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise accepted. For slabs-on-grade, use supports with

- sand plates or horizontal runners where base material will not support chair legs.
7. Tie Wire: 16 gauge black steel.

2.5 CONCRETE FORMS

- A. Forms shall be steel or plywood with finished surface in contact with concrete. Forms shall be free of warps or kinks.
- B. All forms shall be of suitable size and strength, braced and secured adequately to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. All forms shall extend for the full curb depth.
- C. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required.
- D. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete and will not impair subsequent treatments of concrete surfaces.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Curing and Sealing Compound: Conform to NYSDOT Standard Specification 711-05.

2.7 CONTROL OF CONCRETE MIXING IN THE FIELD

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94. Furnish batch ticket information to concrete testing representative.
 1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL - POURED IN PLACE CONCRETE

- A. The contractor is responsible for the complete construction and/or installation of all concrete walks, curbs and other concrete work in accordance with the contract drawings and this specification.
- B. Provide materials necessary to ensure adequate protection of concrete during inclement weather before beginning installation of concrete.
- C. Before beginning concrete placement, inspect formwork, reinforcing steel, and items to be embedded, verifying that all such work has been completed.
- D. If needed, provide runways for wheeled equipment to convey concrete. Do not support runways on reinforcing or wheel equipment directly over reinforcing.
- E. Schedule continuous placement of concrete to prevent the formation of cold joints. Provide

construction joints if concrete for a particular element or component cannot be placed in a continuous operation.

- F. Deposit concrete as close as possible to its final location, to avoid segregation.
- G. Concrete sidewalks shall be protected from damage, by temporary asphalt until such time as the final asphalt is placed.

3.2 PREPARATION

- A. Subgrade: All large stone, organic material, soft clay, spongy material and other deleterious matter exposed during the course of preparing the subgrade shall be excavated and replaced with the specified base course material. The subgrade shall be properly shaped and uniformly compacted to conform with the accepted section, line and grade as indicated on the contract drawings.
- B. Aggregate Subbase Course: The subbase course for concrete pavements shall consist of compacted aggregate placed on the prepared subgrade to the depths indicated on the contract drawings. Roll or tamp aggregate with an approved power roller or mechanical tamper until it is firmly compacted and meets compaction requirements listed in Division 31 Section "Earth Moving".
- C. Remove loose material from compacted subbase prior to concrete placement.

3.3 FORM CONSTRUCTION

- A. Forms shall be full depth, set accurately to line and grade, and be securely staked and held in position throughout placing and curing of concrete. Contractor shall obtain approval of forms for horizontal alignment from the Architect/Engineer prior to placing concrete.
- B. Clean forms after each use and coat with form releasing agent as often as required to ensure separation from concrete without damage.
- C. Allowable tolerances:
 - i. Top of forms not more than 1/8" in 10'
 - ii. Vertical face on longitudinal axis, not more than 1/4" in 10'

3.4 REINFORCEMENT

- A. Wire fabric for concrete reinforcement shall be embedded at mid-depth in the slab. Immediately prior to placing concrete, place all required reinforcing in the forms in accordance with the Contract Drawings. Place reinforcing mesh in such a manner that sheets of mesh overlap adjoining sheets by a minimum of 6 inches both longitudinally and transversely. Place mesh on brick chairs 2 inches above the surface of the subgrade. No reinforcing shall cross expansion joints. Any mesh bent, displaced or ruptured during handling shall be straightened or rewelded.
- B. All outside edges of mesh (or reinforcing) shall not be more than 3 inches or less than 1-1/2 inches from the finished edges of the pavement.

3.5 CONCRETE PLACEMENT

- A. Do not place concrete until subbase and forms have been checked for line and grade. Do not place concrete around manholes or other structures until they are at required finished elevation and alignment.
- B. The subbase shall be wetted immediately prior to placing the concrete for the sidewalk and exterior slabs. Place concrete in the forms to the full depth as indicated on the Contract Drawings and thoroughly vibrate or tamp, ensuring that all honeycombing is eliminated and the surface of the concrete is true to line and grade. Do not use vibrators to move concrete laterally. Consolidate with care to prevent dislocation of reinforcing, dowels or joint devices.
- C. Deposit and spread concrete in a continuous operation.
- D. Place all concrete in forms within 45 minutes of mixing. Discard any concrete in which an initial set has occurred prior to placing.
- E. No retempering of concrete will be permitted and concrete shall not be dropped more than 3 feet.

3.6 JOINTS

- A. When joining existing structures, sidewalks or other pavements place transverse joints to align with previously placed joints, unless otherwise directed.
- B. Provide full depth premolded bituminous joint filler for expansion joints every 20 feet. Intervals in pavement surfaces shall not exceed 20 feet on center in any direction. Expansion joints shall go through curb as well and to the full depth of curb. In addition, place expansion joints wherever concrete pavement abuts curbs, catch basins, inlets, structures, existing walks, building walls, retaining walls, stairs, and, other fixed objects. Joint filler shall be held securely in place so that straight joints results. All expansion joints shall be keyed.
- C. Extend joint fillers full width and depth of joint, not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
- D. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.
- E. Allow concrete pavement to cure a minimum of 10 days prior to the time of installation of joint sealer. Install joint sealer after joint is thoroughly clean and one application of primer has been uniformly and continuously applied and thoroughly dried
- F. Tooled control joints shall be placed every 5 feet. The jointer for tooled joints shall have a 3/4 inch to 1 inch deep bit, with 1/4 inch to 1/2-inch radius. Control Joints shall be performed as soon as possible after slab finishing without possibility of dislodging aggregate.
- G. Joints shall be straight. Joints not straight will require removal of the concrete and replacement.

3.7 CONCRETE FINISHING FOR SIDEWALKS AND RAMPS

- A. Strikeoff to required grade and within surface tolerances indicated. Verify conformance to surface tolerances. Correct deficiencies while concrete is still plastic.
- B. Bull Floating: Immediately following screeding, bull float or darby before bleed water appears, to eliminate ridges, remove surface irregularities, fill in voids, and embed coarse aggregate. Recheck and correct surface tolerances. Refloat repaired areas to provide continuous smooth finish. Surface shall be smooth, even finish, free of any design swirls, float marks etc. Use hand methods only where mechanical floating is not possible.
- C. Work edges of slabs and formed joints with a edging tool, and round to 1/2" radius, unless otherwise indicated. Eliminate tool marks on concrete surface.
- D. Do not perform subsequent finishing until excess moisture or bleed water has disappeared and concrete will support either foot pressure with less than 1/4-inch indentation or weight of power floats without damaging flatness. Complete surface finish as follows:
 - 1. For sidewalks and ramps provide a broom finish by drawing a stiff bristle broom across concrete surface, perpendicular to line of traffic. Provide uniform transverse corrugations approximately 1/16 inch deep, without tearing surface. Repeat operation if required to provide a line texture acceptable to the Architect/Engineer.
 - 2. For ramps and flares only also provide a tooled grooved finish.
 - 3. Finish in accordance with the pattern indicated on the contract drawings.
- E. All pavement edges shall be tooled to round. Along each side of expansion joints, use Goldblatt Edger 2 inches wide, 3/8 inch radius, 1/2 inch lip, Catalogue No. 06260M7 or approved equal. For score joints, use Goldblatt bronze groover bit size 1/2 inch at top, 1 inch deep, 4-1/2 inches wide, Catalogue No. 0631M7 or approved equal.
- F. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Rub all exposed surfaces of concrete. Remove and replace areas or sections with major defects, as directed by the Architect/Engineer.
- G. All lines formed shall be true and straight. The walk surface shall have finish as noted above with exposed tooled edge and joint banding, flush with broomed finish, and free of all ridges.
- H. Curb face shall be hand rubbed to remove all form markings.

3.8 CURING

- A. Curing of the sidewalk and curb shall comply with the requirements of NYSDOT Section 502-3.10. Minimum curing periods for the various types of curing materials used shall comply with the requirements of Table 502-2 in NYSDOT Section 502 latest edition.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

- C. Apply curing compound to all exposed surfaces immediately after finishing operations are completed and surface water has evaporated. Provide curing covers over forms.
- D. The manufacturer's recommendation for application and use of the curing material shall be observed.
- E. Protect all concrete work from traffic and the elements, for a minimum of three days. Do not open pavement to traffic until the Architect/Engineer so directs. Minimum curing periods for the various types of curing materials used shall comply with the requirements of Table 502-2 in NYSDOT Section 502 latest edition.

3.9 SURFACE SEALANT

- A. Immediately upon completion of the concrete curing period apply two coats surface sealant, by means of an approved mechanical pressure spray distributor, capable of maintaining a pressure of 20 to 30 pounds per square inch, to pavement surfaces, which have been cleaned and thoroughly dried. Apply each coat of surface sealant, at the rate specified by the manufacturer, to all exposed surfaces of exterior concrete. Allow specified time to dry thoroughly between applications.
- B. Exercise care in the use of surface sealant solution and avoid causing damage or harm to property and persons in the immediate vicinity of the spray operation.

3.10 SLAB SURFACE TOLERANCES:

- 1. Achieve flat, level planes except where grades are indicated. Slope uniformly to drains.
- 2. Floated finishes: Depressions between high spots shall not exceed 5/16 inch under a 10-foot straightedge.

3.11 WORKMANSHIP

- A. All concrete work shall be first quality and in strict accordance with line and grade and the dimensions indicated on the contract drawings. The average thickness of concrete pavement shall not be deficient by more than 1/4 inch. Any concrete work not constructed or installed in accordance with the contract drawings will not be accepted and shall be removed and replaced at the contractor's expense.
- B. Seasonal Limits: No concrete shall be poured on a frozen or thawing subgrade during inclement weather or when the temperature of the air is less than 38 degrees F.
- C. Protect all concrete surfaces from traffic and the actions of the elements until surface sealant solutions completely dry. Provide barricades and/or fencing when required for a minimum period of 4 hours, or as directed by the Architect/Engineer.
- D. All horizontal and vertical alignments shall be smooth. No abrupt changes in grade or horizontal alignment will be accepted.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Bases and Foundations: Provide equipment bases and foundations as shown on Drawings. Set anchor bolts for equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect/Engineer. Remove and replace concrete that cannot be repaired and patched to Architect/Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½ inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect/Engineer.

3.14 REMOVAL OF EXISTING CONCRETE

- A. Saw cut surfaces or drill holes at regular intervals sufficient to establish a fracture plane for removal by power tools.
- B. Salvage all existing reinforcing; do not cut away until specifically directed by the Architect/Engineer,

or as shown on the Drawings.

C. New work bonded to existing work:

1. Clean and roughen existing surface by sandblasting, waterblasting, scabber, or other approved method.
2. Embed dowels and reinforcing as detailed on the Drawings.
3. Coat surface with bonding agent applied in strict accordance with manufacturer's instructions.

D. Existing work cut away for new work.

1. Saw cutting and removal shall continue to within 1/4 inch of the finished surface. The final 1/4-inch removal shall be completed by grinding to the final surface.
2. Provide bond breaker where new concrete work is adjacent to existing work but structurally separate.

3.15 COLD WEATHER CONCRETING

- A. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions or low temperatures, in compliance with requirements of ACI 306 and as specified.
- B. Cold weather concreting (below 40° F) shall conform to ACI 306-72. Section 6.2 shall not apply.
- C. When air temperature has fallen to or is expected fall below 40° F, provide adequate means to maintain temperature in area where concrete is being placed at 70° F for five days or 50° F. for seven days after placing. Sudden thermal shock due to rapid heating or cooling and rapid dry out due to overheating shall be avoided.
- D. When air temperature has fallen to or is expected to fall below 40° F uniformly heat water and aggregates before mixing, as required, to obtain concrete mixture temperature of not less than 50° F or more than 80° F at time of placement. ACI 306-72, Chapter 2 shall apply only if approved by the Architect/Engineer.
- E. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Forms, reinforcing steel and adjacent concrete surfaces shall be entirely free of frost, snow and ice before placing.

3.16 HOT WEATHER CONCRETING

- A. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305-72 and as specified.
- B. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90° F. Mixing water may be chilled or chopped ice may be used to control concrete temperature. Water added to mix shall be reduced by water content of ice.

- C. Cover reinforcing steel with water soaked burlap if it becomes too hot. Steel temperature shall not exceed air temperature at time of embedment.
- D. Wet forms thoroughly before placing concrete.
- E. Do not use retarding admixtures without written approval of Architect/Engineer.

3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Contractor shall provide free access to Work and cooperate with appointed testing firm.
- B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.
- C. The following tests may be performed by the Owner:
 - 1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - 2. Slump: ASTM C 143; one test for each concrete load at point of discharge; and one test for each set of compressive strength test specimens.
 - 3. Air Content: ASTM C 173; volumetric method for lightweight of normal weight concrete; ASTM C 231 pressure for normal weight concrete; one for each set of compressive strength test specimens.
 - 4. Concrete Temperature: Test hourly when air temperature is 40° F (4° C) and below, and when 80° F (27° C) and above; and each time a set of compression test specimens are made.
 - 5. Compression Test Specimen: ASTM C 31; One composite sample (minimum of 4 cylinders) for each day's pour of each concrete mix exceeding 5 cu. yd, but less than 25 cu. yd., plus one set of four standard cylinders for each additional 50 cu. yd. or fraction thereof. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 6. Compressive Strength Tests: ASTM C 39; one set for each 25 cu. yds. or fraction thereof, of each concrete class placed in any one day; one specimen tested at seven days, two specimens tested at 28 days, one held for later testing as needed.
 - 7. When frequency of testing will provide less than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

8. When strength of field-cure cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
9. Strength level of concrete will be considered satisfactory if averages of sets of two consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.
10. Costs of any additional tests (including costs incurred by the Owner), as well as removal and reconstruction resulting from the failure to meet specified compression strength with the test cylinders, shall be borne by the Contractor. Costs for testing of concrete for replacement of defective concrete or non-conforming concrete (including costs incurred by the Owner and Architect/Engineer) shall be paid by the Contractor.

3.18 DEFECTIVE CONCRETE

A. Defective Concrete:

1. Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
2. Concrete which shows excessive cracking or honeycombing so much that in the opinion of the Architect/Engineer the appearance or use of structure is adversely impacted.
3. Concrete not in conformance with compressive strength testing.

3.19 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
- B. Drill test cores where directed by Architect/Engineer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.
- E. Backfill all concrete work immediately after removal of the forms. Fill material shall be an approved earth or the required aggregate material. Place and compact all backfill material in accordance with the standards as outlined in the Division 31 Section "Earth Moving" and to the line and grade indicated on the Contract Drawings.

END OF SECTION 321313

SECTION 329000 - LANDSCAPE PLANTINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes providing all labor, materials, equipment and services to complete the landscape plantings (trees) including initial maintenance and guarantee.
- B. Related Sections: The following sections contain requirements that relate to this Section.
 - 1. Section 312000, "Earth Moving".

1.3 QUALITY ASSURANCE

- A. Landscape work to be performed by a single firm specializing in landscape work.
- B. Source Quality Control:
 - 1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscapematerials.
 - 2. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Engineer, together with proposal for use of equivalent material.
 - 3. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
 - 4. Topsoil: Before delivery of topsoil, furnish Engineer with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past two years.
 - 5. Plants: Provide plants of quantity, size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock". Provide

healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions or disfigurement.

6. Label at least one plant of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.
7. Inspection: The Engineer may inspect trees and shrubs either in place of growth or

at site before planting, for compliance with requirements for genus, species, variety, size and quality. Engineer retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

- B. Plant and Material Certifications:
 - 1. Certificates of inspection as required by governmental authorities.
 - 2. Manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials.
 - 3. Label data substantiating that plants, trees, shrubs and planting materials comply with specified requirements.

- C. Samples: Submit to Engineer.
 - 1. Weed barrier.
 - 2. Topsoil (when furnished from off-site source).
 - 3. Mulch, as specified.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Plants: Provide freshly dug plants. Do not prune prior to delivery unless otherwise approved by Engineer. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.

- B. Deliver plants after preparations for planting have been completed and plant immediately. If planting is delayed more than six hours after delivery, set plants in shade, protect from weather and mechanical damage and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.

- C. Do not remove container-grown stock from containers until planting time.

1.6 PROJECT CONDITIONS

- A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others

until removal is mutually agreed upon by parties concerned.

- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Engineer before planting.

1.7 SEQUENCING AND SCHEDULING

- A. Planting Schedule: Contractor to submit proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

- B. Planting Time: Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
 - 1. Plant or install materials during normal planting seasons for each type of plant material required. Obtain Engineer's approval before commencing.

 - 2. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

- C. Coordination with Lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Engineer. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.8 GUARANTEE PERIOD AND REPLACEMENTS

- A. All plants, including relocated material shall be guaranteed by the Contractor for not less than one full year from the time of provisional acceptance.

- B. At final acceptance, replace any plant that is missing, dead, not true to name or size as specified, or not in satisfactory growth, as determined by the Engineer. In case of any question regarding the condition and satisfactory establishment of a rejected plant, the Engineer's decision is final. Provide a guarantee for all replacement plants for at least one full growing season.

- C. Replacements: Plants of the same kind and size as specified. Furnish and plant as specified herein at no additional expense to contract.

PART 2 PRODUCTS

2.1 TOPSOIL

- A. Topsoil: Stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.

- B. Topsoil shall conform to the requirements of NYSDOT Standard Specifications Section 713-01, Topsoil.

- C. Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension and other extraneous or toxic matter harmful to plant growth.
 - 1. Obtain topsoil from local sources, naturally, well-drained sites where topsoil occurs in a depth of not less than four inches. Do not obtain from bogs or marshes.

2.2 PLANT MATERIALS

- A. Plants: Conform to the varieties specified in the plant list. Plant names used in the plant list conform to "Standardized Plant Names" by the American Joint Committee on Horticultural Nomenclature. Botanical names take precedence over common names. Ensure plant material is:
 - 1. Hardy under climatic conditions similar to those in the locality of the project.
 - 2. Typical of their species or variety, with a normal habit of growth; sound, healthy and vigorous; well-branched and densely foliated when in leaf; free of disease, insect pests, eggs or larvae; installed with healthy, well developed root systems.
- B. Sizes given on the plant list are minimum. Where a range is given, at least 50% of the plants shall be of the larger size noted.
- C. Quantities shown in the plant list are given for convenience. Install all plants shown on the drawings.
- D. Furnish State or Federal certificates of inspection for materials in inter-state shipments.

2.3 MISCELLANEOUS LANDSCAPE MATERIAL

- A. Planting Fertilizer: Complete Fertilizer, partially organic, delivered in original unopened package bearing the following certified analysis:
 - 10% Nitrogen
 - 10% Phosphorus
 - 10% Potash.
- B. Bone Meal: Commercial raw bone meal, finely ground, having a minimum analysis of 4% nitrogen and 20% phosphoric acid.
- C. Peat Moss: Consist of partially decomposed vegetable matter of natural occurrence, brown, clean, low in content of mineral and woody material, pH 4 to 5, granulated or shredded and free from weedy grasses, edges, rushes or mineral matter harmful to plant growth.
- D. Stakes for guying trees: Sound wood of uniform size, reasonably free from knots, capable of remaining in the ground two years, and of size shown on drawings.
- E. Friction guard: Two-ply fiber bearing, rubber garden hose, not less than 1/2 inch inside

diameter.

- F. Wire for tree bracing and guying: Pliable #12 gauge, galvanized, soft steel wire.
- G. Tree wrapping: First quality, heavy waterproof crepe paper manufactured for this purpose.
- H. Antidesiccant: Shall be Wilt-Pruf concentrate as manufactured by Wilt-Pruf, Transfilm Anti-Transpirant & Sticker as manufactured by Transfilm, Moisture-Loc as manufactured by Zorro Technology, or approved equivalent delivered in manufacturer's containers.

- I. Planting mulch: 50% shredded bark and 50% medium pine bark, double ground to 2 - 3 inch size, uniformly mixed, free from elm, ash, or other diseased wood. Color: Black unless otherwise specified on the plans.
- J. Weed barrier: Commercially available, ultra-violet light resistant, fiberglass mat made of 100% textile glass fiber bonded with phenol formaldehyde resin, roll type, water permeable, and a minimum of 1/4 inch and maximum of 1/2 inch thick with a density of not less than 3/4 lb. per cubic ft. Submit a sample (12" x 12") and anchors etc., along with manufacturer's information to the Engineer for approval.
- K. Weed Retarder: Preen Lawn Weed Control by Lebanon Seaboard Corporation, RM43 Total Vegetation Control by Ragan and Massey, Spectracide Weed Stop by Spectrum Brands Inc, or equal, delivered in manufacturer's containers and used according to manufacturer's instructions.
- L. Watering bags shall be TreeGator as manufactured by W.A. Industries, Inc, Watering Bag as manufactured by Greenscapes, Original Slow Release Watering Bag for Trees by Yangzhou Dandelion Outdoor Equipment Co, or approved equal. for storage of up to 20 gals. Provide one bag per tree up to 4" DBH and 2 bags for trees over 4" DBH.

PART 3 EXECUTION

3.1 PREPARATION - GENERAL

- A. Stake out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Engineer's acceptance before start of planting work. Make adjustments as may be required.

3.2 PREPARATION OF PLANTING SOIL

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps and other extraneous materials harmful or toxic to plant growth.
- B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- C. Mix planting soil prior to backfilling and stockpile at site.

3.3 PREPARATION OF PLANTING BEDS

- A. Loosen subgrade of planting bed areas to a minimum depth of six inches using a culti-mulcher or similar equipment. Remove stones measuring over 1 1/2 inches in any dimension. Remove sticks, stones, rubbish and other extraneous matter.

- B. Spread planting soil mixture to minimum depth required to meet lines, grades and elevations shown after light rolling and natural settlement.
Place approximately 1/2 of total amount of planting soil required. Work into top of loosened

subgrade to create a transition layer, then place remainder of the planting soil.

3.4 EXCAVATION FOR PLANTS

- A. Excavate plant beds, pits and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage.
- B. Plant pits and beds shall be as detailed.
- C. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill unless approved by Engineer.
- D. Fill excavations for plants with water and allow water to percolate out prior to planting.

3.5 PLANTING

- A. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
- B. Set bare root stock on cushion of planting soil mixture. Spread roots and carefully work backfill around roots by hand and puddle with water until backfill layers are completely saturated. Plumb before backfilling and maintain plumb while working backfill around roots and placing layers of soil mixture above roots. Set collar one inch below adjacent finish landscape grades. Spread out roots without tangling or turning up to surface. Cut injured roots clean; do not break.
- C. Set container grown stock, as specified, for balled burlapped stock, except cut cans on two sides with an approved can cutter and remove.
- D. Dish top of backfill to allow for mulching.
- E. Place weed barrier and mulch. Replace or patch weed barrier which becomes torn or damaged. Place and anchor weed barrier per manufacturer's recommendations on the prepared plant bed site. Make holes cut to accept plants generally by cutting an "X" where plants are to be located and place the fabric over the installed tree, shrub or ground cover being careful not to crush plants. Tuck folded-back fabric around plant. Treat plant area with weed retardant in accordance with manufacturer's instructions.

- F. Washed gravel: Place to depth indicated in areas shown on the drawings. Prior to placement of gravel, have weed barrier placed in accordance with manufacturer's instructions.
- G. Apply antidesicant, using power spray, to provide an adequate film over trunks, branches, stems, twigs and foliage.
 - 1. If plants are moved out of the normal planting season treat with antidesicant at

nursery before moving and spray again two weeks after planting.

- H. Prune, thin out and shape plants in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Engineer, do not cut tree leaders and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.
- I. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
- J. Wrap tree trunks of two-inch caliper and larger. Start at ground and cover trunk to height of first branches and securely attach. Inspect tree trunks for injury, improper pruning and infestation and take corrective measures before wrapping.
- K. Guy and stake plants immediately after planting, as detailed.
- L. Provide earth "V" edging at all plant beds of shrubs and/or groundcover.

3.6 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain plants until final acceptance.
- C. Maintain plants by pruning, cultivating, edging, remulching, fertilizing, weeding, and watering as required for healthy growth. Restore planting saucers. **Water plants immediately after planting and thereafter a minimum of 2 times weekly the equivalent of 1" of rain or more often, as required by weather conditions, until acceptance.** Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

3.7 CLEANUP AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

3.8 INSPECTION AND PROVISIONAL ACCEPTANCE

- A. The Engineer will inspect all work for provisional acceptance upon the written request of the Contractor received at least ten days before the anticipated date of inspection.
- B. After all necessary corrective work has been completed, and maintenance instructions have been received by the Owner, Engineer will certify in writing the provisional acceptance of the planting.

3.9 FINAL INSPECTION AND FINAL ACCEPTANCE

- A. At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted by the Landscape Contractor at least ten days before the anticipated date of inspection.
- B. After all necessary corrective work has been completed, the Engineer will certify in writing the final acceptance of the planting.
- C. Upon final acceptance, Owner will assume maintenance and protection of plants.

END OF SECTION 329000

SECTION 329200 – TURF AND GRASSES

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. Restoration and establishment of lawn areas: - This section describes the procedures for: Topsoil Spreading; Soil Preparation; Seeding; Mulches; Maintenance; and Warranty of lawns.

- B. Related Sections:

1. Division 31 Section “**Earth Moving**”

1.3 QUALITY ASSURANCE

- A. Contractor shall retain for inspection the following items:

1. Receipts for all fertilizer, topsoil amendents and grass seed.
2. Seed and fertilizer in unopened bags, bearing the analysis of the contents, and in sufficient quantities to meet the requirements of the project.

- B. All work in conjunction with topsoil placement, seeding and establishing lawns and landscaping shall be performed under the direction of individuals experienced in the establishment of lawns and landscape plantings.

- C. Permanent seeding shall be placed only during the following periods as weather conditions permit:

1. Spring Seeding – Between April 1 (or thereafter when ground becomes workable) and June 1
2. Fall Seeding – Between August 15 and October 15

1.4 WARRANTY

- A. Provide a uniform stand of grass by watering, mowing, and maintaining lawn areas until final acceptance. Reseed seeded areas, which fail to provide a uniform stand of grass, with specified materials until all affected areas are accepted by the Architect/Engineer.

- B. The Contractor shall employ hay or straw bale checks in all swales, at intervals not exceeding 150 lineal feet. Stake bales into grade and clean out all sediment after each storm. Reseed area disturbed by cleaning.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of grass seed.
 - 1. Certification of seed mixture.
- C. Product certificates.
- D. Planting Schedule: Indicating anticipated planting dates for each type of planting

1.6 JOB CONDITIONS

- A. Contractor shall coordinate scheduling of topsoil placement and preparation of topsoil for permanent seeding with the Owner.
- B. The Contractor is responsible to provide mechanically screened topsoil; complete fine grading; maintain topsoil and finish grade; complete preparation of topsoil for permanent seeding; hydroseed; restore areas if eroded, settled, or otherwise disturbed after fine grading; and, provide additional topsoil and restore finish grade where washout or damage occurs before grass is established.
- C. The Contractor is responsible for all erosion control measures. Contractor shall provide straw bales or stoned check dams in ditches or problem swales at intervals required to adequately slow water velocity and impede soil loss.
- D. Lawn Topsoil Limits: All ground area within the indicated contract limit lines, or any additional area which has been disturbed in any way by the construction operations, shall be topsoiled and fine graded by the Contractor for permanent lawn seeding by others, unless otherwise indicated on the drawings to be covered with trees, shrubs, structure(s), walks, roads, or other surfaced areas

1.7 JOB CONDITIONS

- A. Contractor shall coordinate scheduling of topsoil placement, preparation of topsoil for permanent seeding, and seeding to meet the seasonal time frames.
- B. Topsoil placed outside the seasonal times frames shall be temporary seeded by the Contractor, cost to be included in the price bid.
- C. The Contractor is responsible to provide mechanically screened topsoil; complete fine grading; maintain topsoil and finish grade; complete preparation of topsoil; complete seeding and necessary reseeding; restore areas if eroded, settled, or otherwise disturbed after fine grading; and, provide additional topsoil and seed and restore finish grade where washout or damage occurs before grass is established.

- D. The Contractor is responsible for all erosion control measures. Contractor shall provide straw bales or stoned check dams in ditches or problem swales at intervals required to adequately slow water velocity and impede soil loss.
- E. Contractor shall provide mulch for temporary or winter seed and for permanent seed.
- F. Lawn Topsoil Limits: All ground area within the indicated contract limit lines, or any additional area which has been disturbed in any way by the construction operations, shall be topsoiled and fine graded by the Contractor for permanent lawn seeding, unless otherwise indicated on the drawings to be covered with trees, shrubs, structure(s), walks, roads, or other surfaced areas

PART 2 - PRODUCTS

2.1 FERTILIZER

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 10 percent nitrogen, 6 percent phosphorous, and 4 percent potassium, by weight
- B. Cyanamide compounds and hydrated lime are not permitted in fertilizer mixtures.
- C. Fertilizer is not required for temporary seed.

2.2 SEED – EROSION CONTROL AND LAWN MIX

- A. Grade A quality, fresh and re-cleaned and proven to produce satisfactory growth in the locality of the project.
- B. Seed Mix: Fresh, clean and from current season's crop, delivered in original packages, unopened, and bearing guaranteed analysis. Seed shall meet New York State standards of germination and purity.
 - 1. Composed of the following varieties, mixed to the specified proportions by weight, and tested to minimum percentages of purity and germination. Shall be free of: Poa Annua, bent grass, and noxious weed seed such as Canadian Thistle, Coarse Fescue, European Bindweed, Johnson Grass and leafy Spurge. The landscape contractor shall furnish to the Architect/Engineer a signed statement certifying that the seed furnished is from a lot that has been tested by a recognized laboratory. Seed which has become wet, moldy or in any other way damaged in transit or storage, will not be accepted.
 - 2. Permanent Seed Species: Blend - Mix Type 'A' Rate: 5 to 6 pounds per 1,000 SF Provide state-certified (Blue Tag) seed of grass species and percentages as follows:
(Acceptable for all lawn applications)

LAWN MIX	Percent by	Percent	Percent
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Common Names	Weight	Purity	Germination
Adelphi Kentucky Bluegrass	30%	90%	87%
Baron Kentucky Bluegrass	30%	90%	87%
Pennlawn Fescue	30%	90%	82%
Pleasure Perennial Ryegrass	10%	90%	90%

ATHLETIC FIELD MIX	Percent by Weight	Percent Purity	Percent Germination
Common Names			
Midnight II Kentucky Bluegrass	25%	90%	87%
Liberator Kentucky Bluegrass	25%	90%	87%
Challenger Kentucky Bluegrass	20%	90%	87%
Revenge GLX PRG	15%	90%	87%
Paragon GLR PRG	15%	90%	87%

C. Temporary Seed Species for Erosion Control:

1. If spring, summer or early fall, seed with perennial ryegrass at 1 lb per 1,000 SF.
2. If late fall or early winter, seed with Certified “Aroostook” winter rye (cereal rye) at 2.5 lbs. per 1,000 SF.

2.3 MULCH

- A. Straw Mulch: Clean, mildew- and seed free oat or wheat straw well seasoned before baling, free from mature seed bearing stalks or roots of prohibited or noxious weeds.
- B. Hydro Fiber Mulch: Shall be a wood fiber or wood fiber and cellulose mixture, providing the cellulose content does not exceed 20% by volume and is thoroughly mixed with wood fiber mulch. Apply liquid tackifier uniformly at the rate of 60 gallons per acre, to keep straw mulch in place.

Examples of acceptable mulch are:

1. Conweb Hydro-Mulch 2000.
2. Conweb Hydro-Mulch 2500.
3. Mat’s Soil Guard.

2.4 WATER

- A. Free of substance harmful to plant growth. Hoses, pumps, sprinklers or other methods of transportation furnished by Contractor.

2.5 TOPSOIL (See Division 31 Section “Earth Moving”)

A. General Topsoil

1. Approved topsoil, obtained from excavation and grading work or if insufficient material

(either quantity and/or quality) is available, it shall be imported. All topsoil shall be depth as indicated under Spreading Topsoil of this specification.

2. Topsoil shall be natural, friable, fertile soil, characteristic of productive soil in the vicinity, reasonably free of stones, clay lumps, roots and other foreign matter.
3. Store topsoil separately from all other excavated materials on-site and preserve for reuse or replace with imported topsoil meeting the requirements of Division 31 Section "Earth Moving".
4. Stocked or furnished topsoil shall be tested by an approved soil-testing laboratory for determination of correct lime fertilizer additives. Submit mechanical and chemical analysis of off-site topsoil to the Architect/Engineer for approval prior to delivery of topsoil to the site. If more than one source will be used, provide an analysis of each source.
5. Topsoil Source: Imported topsoil shall meet the requirements of Division 31 Section "Earth Moving". Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

2.6 SEEDING ACCESSORIES

A. Weed Killer

If necessary in the opinion of the Architect/Engineer, an application of broadleaf weed killer may be required prior to final acceptance. Ortho Weed-B-Gone or equal at a rate of 3 teaspoons/gallon of water or 3 cups (25 oz.) per 50 gallons of water shall be applied at least 48 hours before watering or anticipated rainfall.

B. Mulch Tackifier

Apply liquid tackifier uniformly at the rate of 60 gallons per acre, if needed, to keep straw mulch in place.

C. Ground Limestone

Shall be applied at a rate sufficient to adjust pH to between 6.0 and 7.0 as determined by the pH testing laboratory. (Laboratory costs paid by the Contractor.) Rate of lime application not to exceed 50 pounds per 1000 sf.

1. Calcic or dolomitic ground limestone.
2. Shall contain not less than 85% of total carbonates.
3. Magnesium oxide - 10% minimum content for dolomitic and high magnesium limes.
4. Sieve Analysis - at least 50% will pass through a No. 100 mesh sieve and 90% will pass through a No. 20 mesh sieve.
5. Coarser material may be used providing the rates of application are increased as approved by the Architect/Engineer.

- D. Packaging: New, clean, sealed and properly labeled bags not exceeding 100 pounds each.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that all underground and above ground work has been completed to the point where topsoiling, fertilizing, seeding and mulching operations may properly commence without unnecessary disturbances at a later date.

3.2 SPREADING TOPSOIL

- A. In areas to be seeded, provide topsoil to a minimum compacted thickness of 6-inches. In the event that insufficient topsoil is not available from stripping the area to be excavated, the Contractor shall import enough additional topsoil to make up the deficit at no additional cost to the Owner.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4-inches to facilitate bonding of the topsoil to the subgrade. Use discs, spike-toothed harrows or other approved means. Clean surface of subgrade of all stones larger than ½-inch in any dimension and all sticks, roots, rubbish, and other extraneous matter and legally dispose of them offsite.
1. Apply slow release fertilizer directly to subgrade before loosening at a rate equal to 1.0 pound of actual nitrogen per 1,000 square feet (430 pounds of fertilizer per acre).
 2. Thoroughly blend planting soil mix off-site before spreading, or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 3. Spread planting soil mix, evenly on the approved prepared subgrade, to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement.
- C. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply slow release fertilizer directly to surface soil before loosening at a rate equal to 1.0 pound of actual nitrogen per 1,000 square feet (430 pounds of fertilizer per acre).
 3. Remove stones larger than 1/2 inch in any dimension and sticks, roots, trash, and other extraneous matter.
 4. Legally dispose of waste material, including grass, vegetation, and turf, offsite.
- D. Carry out spreading so that turfing operations can proceed with a minimum of soil preparation or tilling. Do not spread topsoil when the ground is frozen, excessively wet or otherwise in a condition detrimental to the work in conformance with all legal requirements and in a manner acceptable to the Architect/Engineer.

- E. **Finished Grades:** Shall be understood to be final spot grades and contours indicated on the contract drawings. Where final spot grades or new contours are not indicated, finished grades shall be uniformly level or sloping between points for which elevations are given or contours are shown or shall be graded to the elevations which previously existed. However, final surface grades shall afford positive drainage of all areas at all times.
- F. **Tops and Bottoms of All Slopes:** Round tops and bottoms of slopes and drainage swales. Adjust and warp slopes, at intersections of cuts and fills, to flow into each other or into the existing natural ground surface without noticeable break. Cuts and fills shall have a maximum slope of 3-foot horizontally to 1-foot vertically, unless otherwise shown on the contract drawings.
- G. **Fine Grading Lawn Areas:** Bring the grade of areas to receive lawns to a uniform, level slope, as determined by the use of surveying instruments, by discing, harrowing and other methods approved by the Architect/Engineer. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture.

When establishing finish grades, remove and dispose of all clods, hard lumps, stones and rocks, roots, litter and other foreign matter not passing through the teeth of a hand iron rake. Tractor drawn raking equipment that compacts lawn areas will not be allowed. Dispose of all such materials off-site.

- H. Remove all topsoil spilled on highways, shoulders, sidewalks, driveways and other surfaces for which topsoil is not specified or required.
- I. **Settlement:** Maintain ground surfaces to the finish grades shown on the contract drawings, and deposit whatever additional topsoil that may be required to correct any settlement or erosion that occurs prior to the date of issuance of the Certificate of Final Acceptance. The surface upon which additional topsoil is to be deposited shall be raked or otherwise satisfactorily prepared to ensure a proper bond. Fill hollows that develop from settling, to the finished elevations, with approved topsoil. Finished lawn areas shall be left sufficiently high to meet all paved areas and catch basins after settlement.

3.3 PREPARATION OF TOPSOIL

- A. If the following conditions exist at the time of sowing seed, placing fertilizer and lime, this paragraph may be omitted:
 - 1. Topsoil has been spread and raked clean within the past 10 days and is shaped to the required grade.
 - 2. Topsoil was spread more than 10 days ago but the top 3-inches is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter and shaped to the required grade.
- B. If any of the above conditions do not exist, then prepare the topsoil in accordance with the following paragraphs.
- C. Repair all eroded and damaged surfaces, cut or otherwise remove all weeds and grass and scarify or otherwise loosen topsoil to a depth of not less than 3 inches.

- D. Break up large, stiff clods, and hard lumps, and rake off all stones and rocks larger than 1-inch in size, roots, litter, foreign matter, poisonous materials, and other materials, which may be detrimental to the work. Dispose of all such materials off-site in conformance with all legal requirements and in a manner acceptable to the Architect/Engineer.
- E. Liming (used when required to adjust pH of topsoil):
 - 1. Apply separately at a rate sufficient to bring the pH of the topsoil between 6.0 and 7.0 as determined by the pH-testing lab, prior to fertilizing, seeding and sodding. Lime may be applied dry by spreader or as an aqueous solution by spraying. Rate of lime application not to exceed 50 lbs per 1000 sf.
 - 2. After application, work lime into the top 3-inches of topsoil and redress surface to a smooth finish.

3.4 SEEDING LAWNS AREAS

- A. Seeding Limits: All ground area within the indicated contract limit lines, or any additional area which has been disturbed in any way by the construction operations, shall be fine graded and planted with lawn seed mix unless otherwise indicated on the drawings to be covered with trees, shrubs, structure(s), walks, roads, or other surfaced areas.
- B. Responsibility: The Contractor shall utilize all such measures as may be necessary, including, but not limited to, protective fencing, sod, or erosion control netting to produce a finished continuous blanket of turf over all areas designated to receive lawns.
- C. Fertilizer (Dry)
 - 1. Apply fertilizer to indicated lawn areas at a rate equal to 1.0 pound of actual nitrogen per 1,000 square feet (430 pounds of fertilizer per acre).
 - 2. Apply fertilizers by mechanical rotary or drop type distributor, thoroughly and evenly incorporated into soil to a depth of 3-inches, by discing or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.
 - 3. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed, after fine grading and prior to seeding.
- D. Seeding Operations (Lawns Only)
 - 1. Dry Seeding
 - a. Seed immediately after preparation of bed and meeting seasonal time frames.
 - b. Seed indicated areas, within contract limits and areas adjoining contract limits, disturbed as a result of construction operations.
 - c. Perform seeding operations when the soil is dry and when winds do not exceed 5 miles per hour velocity.
 - d. Apply seed with a rotary or drop type distributor. Install seed evenly by sowing equal quantities in two directions, at right angles to each other.
 - e. Sow grass seed at rate recommended by seed vendor and approved by the Architect/Engineer. The total rate of seed application shall be based upon "new lawn" requirements and shall not be less than 5 pounds per 1,000 square feet.
 - f. After seeding, lightly rake or drag surface of soil to incorporate seed into top 1/8-inch of soil. Roll with light lawn roller.

- E. Fertilizing and Seeding (Wet-Hydro Seeding)
1. Contractor may apply seed and fertilizer by spraying them in the form of an aqueous mixture. Water used shall be fresh water free from injurious chemicals and other toxic substances harmful to plant life.
 2. Equipment shall be of a type made specifically for this purpose and capable of maintaining a uniform mixture, even when not spraying. Use a hydromulcher (sprayer).
 3. Apply mixture(s) at the following rates. Mix in accordance with manufacturer's recommendations. Protect all paving, buildings, plantings and all nonseeded areas from over spraying of hydroseed mixture. Contractor shall clean up unwanted deposits at his expense.

LAWN SEED

- a. Grass Seed: 175 pounds/acre.
 - b. Fertilizer: 430 pounds/acre.
 - c. Tackifier: 60 gallons/acre.
 - d. Wood Cellulose Fiber Mulch: 2,000 pounds/acre.
4. Roll seeded surfaces if mulch is not used and only after soil has dried. Roll with light lawn roller.
 5. A non-harmful color additive, which colors the hydroseed mixture green, shall be added to the mixture to allow visual metering of its application. The hydroseed mixture shall be sprayed upgrade and uniformly on the surface of the soil to form an absorbent cover, allowing percolation of water to the underlying soil.
- F. Mulching of Lawn Areas (Lawns Only)
1. Place straw mulch on seeded areas within 24 hours after seeding.
 2. Place straw mulch uniformly, in a continuous blanket, at the rate of 2-1/2 tons per acre or two 50-pound bales per 1,000 square feet of area. A mechanical blower may be used for straw mulch application, when acceptable to the Architect/Engineer.
 3. Anchor straw mulch with liquid tackifier, applied uniformly at a rate of 60 gallons per acre.
 4. Protect all paving, buildings, plantings and all nonseeded areas from liquid tackifier over-spray.
 5. Provide straw bales checking in ditches or problem swales at intervals required to adequately slow water velocity and impede soil loss.

3.5 MAINTENANCE FOR PERMANENT LAWN AREAS

- A. Contractor shall roll, regrade and re-topsoil washed out, eroded, settled or damaged areas as required.
- B. Maintain seeded areas for a period of at least **60** days after completion and final acceptance of seeding operations.
- C. Maintain seeded areas, including watering, spot weeding, mowing, applications of herbicides, fungicides, insecticides and reseeding until a full, uniform stand of grass free of weeds, undesirable grass species, disease and insects is achieved and accepted by the Architect/Engineer.
- D. Water daily to maintain adequate surface soil moisture for proper seed germination. Continue watering as necessary to establish a full uniform stand of grass and until final acceptance.

- E. Repair, rework, and reseed all areas where seed fails to germinate or where seeded areas have been damaged by wash out, erosion, people, vehicular traffic, or other causes.
- F. Mow lawn areas as soon as lawn top growth exceeds a 3-inches in height. Cut back to 2-1/2-inches in height. Repeat mowing as required to maintain specified height of 2-1/2-inches inches until accepted by the Owner's Designated Representative.
- G. Apply fertilizer to lawns (only) approximately 30 days after seeding, at a rate equal to 0.3 pounds of actual nitrogen per 1,000 square feet (140 pounds/acre). Apply with mechanical rotary or drop type distributor. Thoroughly water into soil.
- H. Maintain seeded banks, ditches, medians and fields. Regrade and reseed washed out or eroded areas as required, until a suitable cover is established.

3.6 MAINTENANCE FOR TEMPORARY LAWN AREAS

- A. Contractor shall roll, regrade, re-topsoil and reseed, washed out, eroded, settled or damaged areas as required.
- B. Contractor shall establish and maintain temporary lawn by seeding, watering, reseeding, and other operations.
- C. Mowing of temporary seeded areas for erosion control is not required.

3.7 FINAL ACCEPTANCE

- A. Inspection to determine final acceptance of seeded lawns will be made by the Architect/Engineer upon Contractor's request. Provide notification at least 10 working days before requested inspection date.
 - 1. Seeded areas will be acceptable provided all requirements, including maintenance, have been completed and a healthy, uniform, close stand of the specified grass is established, free of weeds, undesirable grass species, disease and insects.
 - 2. In areas requested to be inspected, no individual seeded areas shall have bare spots or unacceptable cover totaling more than 2% of the individual areas.
- B. Upon final acceptance of the seeding operations and completion of the maintenance period, the Owner will assume lawn maintenance.

END OF SECTION 329200

SECTION 329200 – TURF AND GRASSES

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. Restoration and establishment of lawn areas: - This section describes the procedures for: Topsoil Spreading; Soil Preparation; Seeding; Mulches; Maintenance; and Warranty of lawns.

- B. Related Sections:

1. Division 31 Section “**Earth Moving**”

1.3 QUALITY ASSURANCE

- A. Contractor shall retain for inspection the following items:

1. Receipts for all fertilizer, topsoil amendents and grass seed.
2. Seed and fertilizer in unopened bags, bearing the analysis of the contents, and in sufficient quantities to meet the requirements of the project.

- B. All work in conjunction with topsoil placement, seeding and establishing lawns and landscaping shall be performed under the direction of individuals experienced in the establishment of lawns and landscape plantings.

- C. Permanent seeding shall be placed only during the following periods as weather conditions permit:

1. Spring Seeding – Between April 1 (or thereafter when ground becomes workable) and June 1
2. Fall Seeding – Between August 15 and October 15

1.4 WARRANTY

- A. Provide a uniform stand of grass by watering, mowing, and maintaining lawn areas until final acceptance. Reseed seeded areas, which fail to provide a uniform stand of grass, with specified materials until all affected areas are accepted by the Architect/Engineer.

- B. The Contractor shall employ hay or straw bale checks in all swales, at intervals not exceeding 150 lineal feet. Stake bales into grade and clean out all sediment after each storm. Reseed area disturbed by cleaning.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of grass seed.
 - 1. Certification of seed mixture.
- C. Product certificates.
- D. Planting Schedule: Indicating anticipated planting dates for each type of planting

1.6 JOB CONDITIONS

- A. Contractor shall coordinate scheduling of topsoil placement and preparation of topsoil for permanent seeding with the Owner.
- B. The Contractor is responsible to provide mechanically screened topsoil; complete fine grading; maintain topsoil and finish grade; complete preparation of topsoil for permanent seeding; hydroseed; restore areas if eroded, settled, or otherwise disturbed after fine grading; and, provide additional topsoil and restore finish grade where washout or damage occurs before grass is established.
- C. The Contractor is responsible for all erosion control measures. Contractor shall provide straw bales or stoned check dams in ditches or problem swales at intervals required to adequately slow water velocity and impede soil loss.
- D. Lawn Topsoil Limits: All ground area within the indicated contract limit lines, or any additional area which has been disturbed in any way by the construction operations, shall be topsoiled and fine graded by the Contractor for permanent lawn seeding by others, unless otherwise indicated on the drawings to be covered with trees, shrubs, structure(s), walks, roads, or other surfaced areas

1.7 JOB CONDITIONS

- A. Contractor shall coordinate scheduling of topsoil placement, preparation of topsoil for permanent seeding, and seeding to meet the seasonal time frames.
- B. Topsoil placed outside the seasonal times frames shall be temporary seeded by the Contractor, cost to be included in the price bid.
- C. The Contractor is responsible to provide mechanically screened topsoil; complete fine grading; maintain topsoil and finish grade; complete preparation of topsoil; complete seeding and necessary reseeding; restore areas if eroded, settled, or otherwise disturbed after fine grading; and, provide additional topsoil and seed and restore finish grade where washout or damage occurs before grass is established.

- D. The Contractor is responsible for all erosion control measures. Contractor shall provide straw bales or stoned check dams in ditches or problem swales at intervals required to adequately slow water velocity and impede soil loss.
- E. Contractor shall provide mulch for temporary or winter seed and for permanent seed.
- F. Lawn Topsoil Limits: All ground area within the indicated contract limit lines, or any additional area which has been disturbed in any way by the construction operations, shall be topsoiled and fine graded by the Contractor for permanent lawn seeding, unless otherwise indicated on the drawings to be covered with trees, shrubs, structure(s), walks, roads, or other surfaced areas

PART 2 - PRODUCTS

2.1 FERTILIZER

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 10 percent nitrogen, 6 percent phosphorous, and 4 percent potassium, by weight
- B. Cyanamide compounds and hydrated lime are not permitted in fertilizer mixtures.
- C. Fertilizer is not required for temporary seed.

2.2 SEED – EROSION CONTROL AND LAWN MIX

- A. Grade A quality, fresh and recleaned and proven to produce satisfactory growth in the locality of the project.
- B. Seed Mix: Fresh, clean and from current season’s crop, delivered in original packages, unopened, and bearing guaranteed analysis. Seed shall meet New York State standards of germination and purity.
 - 1. Composed of the following varieties, mixed to the specified proportions by weight, and tested to minimum percentages of purity and germination. Shall be free of: Poa Annua, bent grass, and noxious weed seed such as Canadian Thistle, Coarse Fescue, European Bindweed, Johnson Grass and leafy Spurge. The landscape contractor shall furnish to the Architect/Engineer a signed statement certifying that the seed furnished is from a lot that has been tested by a recognized laboratory. Seed which has become wet, moldy or in any other way damaged in transit or storage, will not be accepted.
 - 2. Permanent Seed Species: Blend - Mix Type 'A' Rate: 5 to 6 pounds per 1,000 SF Provide state-certified (Blue Tag) seed of grass species and percentages as follows:
(Acceptable for all lawn applications)

LAWN MIX	Percent by	Percent	Percent
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Common Names	Weight	Purity	Germination
Adelphi Kentucky Bluegrass	30%	90%	87%
Baron Kentucky Bluegrass	30%	90%	87%
Pennlawn Fescue	30%	90%	82%
Pleasure Perennial Ryegrass	10%	90%	90%

ATHLETIC FIELD MIX	Percent by Weight	Percent Purity	Percent Germination
Common Names			
Midnight II Kentucky Bluegrass	25%	90%	87%
Liberator Kentucky Bluegrass	25%	90%	87%
Challenger Kentucky Bluegrass	20%	90%	87%
Revenge GLX PRG	15%	90%	87%
Paragon GLR PRG	15%	90%	87%

C. Temporary Seed Species for Erosion Control:

1. If spring, summer or early fall, seed with perennial ryegrass at 1 lb per 1,000 SF.
2. If late fall or early winter, seed with Certified "Aroostook" winter rye (cereal rye) at 2.5 lbs. per 1,000 SF.

2.3 MULCH

- A. Straw Mulch: Clean, mildew- and seed free oat or wheat straw well seasoned before baling, free from mature seed bearing stalks or roots of prohibited or noxious weeds.
- B. Hydro Fiber Mulch: Shall be a wood fiber or wood fiber and cellulose mixture, providing the cellulose content does not exceed 20% by volume and is thoroughly mixed with wood fiber mulch. Apply liquid tackifier uniformly at the rate of 60 gallons per acre, to keep straw mulch in place.

Examples of acceptable mulch are:

1. Conweb Hydro-Mulch 2000.
2. Conweb Hydro-Mulch 2500.
3. Mat's Soil Guard.

2.4 WATER

- A. Free of substance harmful to plant growth. Hoses, pumps, sprinklers or other methods of transportation furnished by Contractor.

2.5 TOPSOIL (See Division 31 Section "Earth Moving")

A. General Topsoil

1. Approved topsoil, obtained from excavation and grading work or if insufficient material

(either quantity and/or quality) is available, it shall be imported. All topsoil shall be depth as indicated under Spreading Topsoil of this specification.

2. Topsoil shall be natural, friable, fertile soil, characteristic of productive soil in the vicinity, reasonably free of stones, clay lumps, roots and other foreign matter.
3. Store topsoil separately from all other excavated materials on-site and preserve for reuse or replace with imported topsoil meeting the requirements of Division 31 Section "Earth Moving".
4. Stocked or furnished topsoil shall be tested by an approved soil-testing laboratory for determination of correct lime fertilizer additives. Submit mechanical and chemical analysis of off-site topsoil to the Architect/Engineer for approval prior to delivery of topsoil to the site. If more than one source will be used, provide an analysis of each source.
5. Topsoil Source: Imported topsoil shall meet the requirements of Division 31 Section "Earth Moving". Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

2.6 SEEDING ACCESSORIES

A. Weed Killer

If necessary in the opinion of the Architect/Engineer, an application of broadleaf weed killer may be required prior to final acceptance. Ortho Weed-B-Gone or equal at a rate of 3 teaspoons/gallon of water or 3 cups (25 oz.) per 50 gallons of water shall be applied at least 48 hours before watering or anticipated rainfall.

B. Mulch Tackifier

Apply liquid tackifier uniformly at the rate of 60 gallons per acre, if needed, to keep straw mulch in place.

C. Ground Limestone

Shall be applied at a rate sufficient to adjust pH to between 6.0 and 7.0 as determined by the pH testing laboratory. (Laboratory costs paid by the Contractor.) Rate of lime application not to exceed 50 pounds per 1000 sf.

1. Calcic or dolomitic ground limestone.
2. Shall contain not less than 85% of total carbonates.
3. Magnesium oxide - 10% minimum content for dolomitic and high magnesium limes.
4. Sieve Analysis - at least 50% will pass through a No. 100 mesh sieve and 90% will pass through a No. 20 mesh sieve.
5. Coarser material may be used providing the rates of application are increased as approved by the Architect/Engineer.

- D. Packaging: New, clean, sealed and properly labeled bags not exceeding 100 pounds each.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that all underground and above ground work has been completed to the point where topsoiling, fertilizing, seeding and mulching operations may properly commence without unnecessary disturbances at a later date.

3.2 SPREADING TOPSOIL

- A. In areas to be seeded, provide topsoil to a minimum compacted thickness of 6-inches. In the event that insufficient topsoil is not available from stripping the area to be excavated, the Contractor shall import enough additional topsoil to make up the deficit at no additional cost to the Owner.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4-inches to facilitate bonding of the topsoil to the subgrade. Use discs, spike-toothed harrows or other approved means. Clean surface of subgrade of all stones larger than ½-inch in any dimension and all sticks, roots, rubbish, and other extraneous matter and legally dispose of them offsite.
1. Apply slow release fertilizer directly to subgrade before loosening at a rate equal to 1.0 pound of actual nitrogen per 1,000 square feet (430 pounds of fertilizer per acre).
 2. Thoroughly blend planting soil mix off-site before spreading, or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 3. Spread planting soil mix, evenly on the approved prepared subgrade, to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement.
- C. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply slow release fertilizer directly to surface soil before loosening at a rate equal to 1.0 pound of actual nitrogen per 1,000 square feet (430 pounds of fertilizer per acre).
 3. Remove stones larger than 1/2 inch in any dimension and sticks, roots, trash, and other extraneous matter.
 4. Legally dispose of waste material, including grass, vegetation, and turf, offsite.
- D. Carry out spreading so that turfing operations can proceed with a minimum of soil preparation or tilling. Do not spread topsoil when the ground is frozen, excessively wet or otherwise in a condition detrimental to the work in conformance with all legal requirements and in a manner acceptable to the Architect/Engineer.

- E. **Finished Grades:** Shall be understood to be final spot grades and contours indicated on the contract drawings. Where final spot grades or new contours are not indicated, finished grades shall be uniformly level or sloping between points for which elevations are given or contours are shown or shall be graded to the elevations which previously existed. However, final surface grades shall afford positive drainage of all areas at all times.
- F. **Tops and Bottoms of All Slopes:** Round tops and bottoms of slopes and drainage swales. Adjust and warp slopes, at intersections of cuts and fills, to flow into each other or into the existing natural ground surface without noticeable break. Cuts and fills shall have a maximum slope of 3-foot horizontally to 1-foot vertically, unless otherwise shown on the contract drawings.
- G. **Fine Grading Lawn Areas:** Bring the grade of areas to receive lawns to a uniform, level slope, as determined by the use of surveying instruments, by discing, harrowing and other methods approved by the Architect/Engineer. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture.

When establishing finish grades, remove and dispose of all clods, hard lumps, stones and rocks, roots, litter and other foreign matter not passing through the teeth of a hand iron rake. Tractor drawn raking equipment that compacts lawn areas will not be allowed. Dispose of all such materials off-site.

- H. Remove all topsoil spilled on highways, shoulders, sidewalks, driveways and other surfaces for which topsoil is not specified or required.
- I. **Settlement:** Maintain ground surfaces to the finish grades shown on the contract drawings, and deposit whatever additional topsoil that may be required to correct any settlement or erosion that occurs prior to the date of issuance of the Certificate of Final Acceptance. The surface upon which additional topsoil is to be deposited shall be raked or otherwise satisfactorily prepared to ensure a proper bond. Fill hollows that develop from settling, to the finished elevations, with approved topsoil. Finished lawn areas shall be left sufficiently high to meet all paved areas and catch basins after settlement.

3.3 PREPARATION OF TOPSOIL

- A. If the following conditions exist at the time of sowing seed, placing fertilizer and lime, this paragraph may be omitted:
 - 1. Topsoil has been spread and raked clean within the past 10 days and is shaped to the required grade.
 - 2. Topsoil was spread more than 10 days ago but the top 3-inches is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter and shaped to the required grade.
- B. If any of the above conditions do not exist, then prepare the topsoil in accordance with the following paragraphs.
- C. Repair all eroded and damaged surfaces, cut or otherwise remove all weeds and grass and scarify or otherwise loosen topsoil to a depth of not less than 3 inches.

- D. Break up large, stiff clods, and hard lumps, and rake off all stones and rocks larger than 1-inch in size, roots, litter, foreign matter, poisonous materials, and other materials, which may be detrimental to the work. Dispose of all such materials off-site in conformance with all legal requirements and in a manner acceptable to the Architect/Engineer.
- E. Liming (used when required to adjust pH of topsoil):
 - 1. Apply separately at a rate sufficient to bring the pH of the topsoil between 6.0 and 7.0 as determined by the pH-testing lab, prior to fertilizing, seeding and sodding. Lime may be applied dry by spreader or as an aqueous solution by spraying. Rate of lime application not to exceed 50 lbs per 1000 sf.
 - 2. After application, work lime into the top 3-inches of topsoil and redress surface to a smooth finish.

3.4 SEEDING LAWNS AREAS

- A. Seeding Limits: All ground area within the indicated contract limit lines, or any additional area which has been disturbed in any way by the construction operations, shall be fine graded and planted with lawn seed mix unless otherwise indicated on the drawings to be covered with trees, shrubs, structure(s), walks, roads, or other surfaced areas.
- B. Responsibility: The Contractor shall utilize all such measures as may be necessary, including, but not limited to, protective fencing, sod, or erosion control netting to produce a finished continuous blanket of turf over all areas designated to receive lawns.
- C. Fertilizer (Dry)
 - 1. Apply fertilizer to indicated lawn areas at a rate equal to 1.0 pound of actual nitrogen per 1,000 square feet (430 pounds of fertilizer per acre).
 - 2. Apply fertilizers by mechanical rotary or drop type distributor, thoroughly and evenly incorporated into soil to a depth of 3-inches, by discing or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.
 - 3. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed, after fine grading and prior to seeding.
- D. Seeding Operations (Lawns Only)
 - 1. Dry Seeding
 - a. Seed immediately after preparation of bed and meeting seasonal time frames.
 - b. Seed indicated areas, within contract limits and areas adjoining contract limits, disturbed as a result of construction operations.
 - c. Perform seeding operations when the soil is dry and when winds do not exceed 5 miles per hour velocity.
 - d. Apply seed with a rotary or drop type distributor. Install seed evenly by sowing equal quantities in two directions, at right angles to each other.
 - e. Sow grass seed at rate recommended by seed vendor and approved by the Architect/Engineer. The total rate of seed application shall be based upon "new lawn" requirements and shall not be less than 5 pounds per 1,000 square feet.
 - f. After seeding, lightly rake or drag surface of soil to incorporate seed into top 1/8-inch of soil. Roll with light lawn roller.

- E. Fertilizing and Seeding (Wet-Hydro Seeding)
1. Contractor may apply seed and fertilizer by spraying them in the form of an aqueous mixture. Water used shall be fresh water free from injurious chemicals and other toxic substances harmful to plant life.
 2. Equipment shall be of a type made specifically for this purpose and capable of maintaining a uniform mixture, even when not spraying. Use a hydromulcher (sprayer).
 3. Apply mixture(s) at the following rates. Mix in accordance with manufacturer's recommendations. Protect all paving, buildings, plantings and all nonseeded areas from over spraying of hydroseed mixture. Contractor shall clean up unwanted deposits at his expense.

LAWN SEED

- a. Grass Seed: 175 pounds/acre.
 - b. Fertilizer: 430 pounds/acre.
 - c. Tackifier: 60 gallons/acre.
 - d. Wood Cellulose Fiber Mulch: 2,000 pounds/acre.
4. Roll seeded surfaces if mulch is not used and only after soil has dried. Roll with light lawn roller.
 5. A non-harmful color additive, which colors the hydroseed mixture green, shall be added to the mixture to allow visual metering of its application. The hydroseed mixture shall be sprayed upgrade and uniformly on the surface of the soil to form an absorbent cover, allowing percolation of water to the underlying soil.
- F. Mulching of Lawn Areas (Lawns Only)
1. Place straw mulch on seeded areas within 24 hours after seeding.
 2. Place straw mulch uniformly, in a continuous blanket, at the rate of 2-1/2 tons per acre or two 50-pound bales per 1,000 square feet of area. A mechanical blower may be used for straw mulch application, when acceptable to the Architect/Engineer.
 3. Anchor straw mulch with liquid tackifier, applied uniformly at a rate of 60 gallons per acre.
 4. Protect all paving, buildings, plantings and all nonseeded areas from liquid tackifier over-spray.
 5. Provide straw bales checking in ditches or problem swales at intervals required to adequately slow water velocity and impede soil loss.

3.5 MAINTENANCE FOR PERMANENT LAWN AREAS

- A. Contractor shall roll, regrade and re-topsoil washed out, eroded, settled or damaged areas as required.
- B. Maintain seeded areas for a period of at least **60** days after completion and final acceptance of seeding operations.
- C. Maintain seeded areas, including watering, spot weeding, mowing, applications of herbicides, fungicides, insecticides and reseeding until a full, uniform stand of grass free of weeds, undesirable grass species, disease and insects is achieved and accepted by the Architect/Engineer.
- D. Water daily to maintain adequate surface soil moisture for proper seed germination. Continue watering as necessary to establish a full uniform stand of grass and until final acceptance.

- E. Repair, rework, and reseed all areas where seed fails to germinate or where seeded areas have been damaged by wash out, erosion, people, vehicular traffic, or other causes.
- F. Mow lawn areas as soon as lawn top growth exceeds a 3-inches in height. Cut back to 2-1/2-inches in height. Repeat mowing as required to maintain specified height of 2-1/2-inches inches until accepted by the Owner's Designated Representative.
- G. Apply fertilizer to lawns (only) approximately 30 days after seeding, at a rate equal to 0.3 pounds of actual nitrogen per 1,000 square feet (140 pounds/acre). Apply with mechanical rotary or drop type distributor. Thoroughly water into soil.
- H. Maintain seeded banks, ditches, medians and fields. Regrade and reseed washed out or eroded areas as required, until a suitable cover is established.

3.6 MAINTENANCE FOR TEMPORARY LAWN AREAS

- A. Contractor shall roll, regrade, re-topsoil and reseed, washed out, eroded, settled or damaged areas as required.
- B. Contractor shall establish and maintain temporary lawn by seeding, watering, reseeding, and other operations.
- C. Mowing of temporary seeded areas for erosion control is not required.

3.7 FINAL ACCEPTANCE

- A. Inspection to determine final acceptance of seeded lawns will be made by the Architect/Engineer upon Contractor's request. Provide notification at least 10 working days before requested inspection date.
 - 1. Seeded areas will be acceptable provided all requirements, including maintenance, have been completed and a healthy, uniform, close stand of the specified grass is established, free of weeds, undesirable grass species, disease and insects.
 - 2. In areas requested to be inspected, no individual seeded areas shall have bare spots or unacceptable cover totaling more than 2% of the individual areas.
- B. Upon final acceptance of the seeding operations and completion of the maintenance period, the Owner will assume lawn maintenance.

END OF SECTION 329200

SECTION 331117 – SITE WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Extent of water service work includes, but is not limited to the following
 - 1. Furnish and install water main service(s) from limits as shown on the Contract Plans.
 - 2. Complete connection(s) to existing water main.
- B. Site Contractor's responsibility shall be as shown on the contract drawings.
- C. The Site Contractor shall coordinate with the other Contractors to provide temporary service if necessary.
- D. Related Requirements:
 - 1. Current version of Niagara County Water District Requirements.

1.3 QUALITY ASSURANCE

- A. Pipe, pipe fittings, valves, hydrants, and all other appurtenances shall be produced in a plant of recognized reputation that is regularly engaged in the production of these materials conforming to the specified standards.
- B. All pipe, pipe fittings, valves, hydrants, and all other appurtenances shall be of good quality and free from defects which would make it unfit for the use intended.
- C. Pipe and pipe fittings, and appurtenances of the same type shall be the product of a single manufacturer.
- D. Tapping of live water mains shall be completed by a company or personnel specializing in these types of connections and with a minimum of three years documented experience.
- E. Pressure testing and disinfection of the new water distribution piping systems and parts of the existing system that have been altered, extended or repaired shall be completed by a company or personnel familiar with the required procedures and with a minimum of three years documented experience.

- F. Bacteriological samples and the performing of bacteriological testing shall be completed by the Niagara County Department of Health. Coordination shall be completed by the Contractor, who will bear all costs.
- G. Contractor shall provide a minimum of 2 working days notification prior to work requiring the Owner to operate existing valves.
- H. Contractor shall provide a minimum of 2 working days notification to the Architect/Engineer for witnessing of the pressure test and chlorine fill of the water service. The Contractor shall perform a pressure pre-test of the water service to show it meets the pressure test requirements prior to scheduling with the Architect/Engineer for the official test. The Architect/Engineer or his designated representative will witness the full duration of the pressure test.
- I. Permission is required from the Owner to use water from fire hydrants. Water use requires the use of a meter and backflow preventer. The Contractor shall supply the meter and backflow preventer.
- J. The Fire Marshal/Fire Chief shall be notified in writing 48 hours prior to existing hydrants being taken out of service. The out-of-service hydrants shall be marked appropriately. The Fire Marshal/Fire Chief shall be notified when new and/or existing hydrants are placed in service.

1.4 SUBMITTALS

- A. Submit catalog cuts and manufacturer's data and shop drawings for valves, valve boxes, post indicators, hydrants, curb stops, curb boxes, corporation stops, service saddles, and all appurtenances.
- B. Shop drawings, catalog cuts, and manufacturer's literature for all pipe and pipe fittings to include coatings and linings, material specifications, dimensions, tolerances, and all related data shall be submitted.
- C. Submit catalog cuts and manufacturer's data and shop drawings for tapping sleeve and valve and valve box. Submit copies of manufacturer's certification that materials meet specified standards.
- D. Manufacturer's certification that valves, valve boxes, post indicators, hydrants, curb stops, curb boxes, corporation stops, service saddles, and all other appurtenances meets the required specifications shall be submitted.
- E. Manufacturer's certification that pipe supplied meets the required specifications shall be submitted.
- F. Pipe manufacturers shall furnish Certificates of Compliance on pipe, with each load of pipe supplied. Immediately turn certificates over to Architect/Engineer. Materials delivered to the site without accompanying certificates will be subject to rejection.

- G. Shop drawings showing the proposed methods and procedures for connecting to existing pipelines shall be submitted to the Architect/Engineer for approval.
- H. Shop drawings and catalog cuts for methods of anchoring pipe bends, if other than concrete reaction blocking, shall be submitted. If joint method is chosen, calculations indicating how many pipe joints will be anchored shall also be submitted.
- I. The Contractor shall record the location and size of the water main and appurtenances. Horizontal tie data for all fittings, bends and utility crossings shall be submitted. Provide actual vertical clearance data from outside face to outside face at each utility crossing of the water service (i.e. storm, sanitary, electric, fiber, telephone, etc).
- J. Shop drawings and catalog cuts of adapters for joining of pipes of different materials and for caps and plugs at ends of pipelines shall be submitted. Verify who needs to sample, Delete sentence below if contractor not hiring
- K. Submit the name and certification documentation for the independent NYS Health Department approved laboratory to be utilized by Contractor for bacteriological sampling and testing.
- L. Submit certified copies of the bacteriological testing results with mapping showing the locations the test results cover.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Each length of pipe delivered to the site shall be clearly marked at the factory with the name of the manufacturer, class of pipe, pipe diameter and all else as required by the codes, standards, and specifications referred to under this section. Omission of this information will be cause for rejection of pipe.
- B. Store all materials in accordance with manufacturer's approved instructions. Store all materials so they can be easily inspected and so they will not be damaged prior to installation.
- C. Carefully handle all pipes and fittings when loading and unloading to avoid damage to pipe, coatings, or linings. Pipe or fittings with damaged coatings or linings shall be repaired or replaced by the Contractor at his expense and to the satisfaction of the Architect/Engineer. Lift pipes and fittings by hoists or lower on skid ways in a manner to avoid shock. Lower pipe into trench with derricks, rope, or suitable equipment for the safety and protection of workmen, materials, equipment, property, and the work.
- D. Do not dump or drop pipe and fittings. Those that are dumped or dropped are subject to rejection by Architect/Engineer.

1.6 ABBREVIATIONS:

CIP Cast Iron Pipe

CU	Copper Service Tubing
DIP	Ductile Iron Pipe
PE	Polyethylene Pressure Tubing
PVC	Polyvinyl Chloride Pipe

1.7 MATERIAL TESTS

- A. Various tests and checks shall be performed, as specified herein, to determine compliance with the specifications and drawings. The Contractor is advised that failure of a test is suitable grounds for the Architect/Engineer to order that portion of the work removed and reconstructed, if necessary, to meet the requirements of the Contract Documents.

1.8 JOB CONDITIONS

- A. The Drawings indicate the required pipe sizes and locations of all structures, piping and appurtenances. Verify all locations and immediately notify Architect/Engineer of any discrepancies or conflicts.
- B. Contractor shall verify that survey benchmark and intended elevations for the work are as indicated. Contractor shall verify existing site conditions.
- C. Utilities shown on the Contract Drawings are for the convenience of the Contractor, exact locations are not guaranteed. The Contractor shall verify existing utilities with the proper authorities.
- D. The Contractor shall take precautions to protect from harm the work of other contractors on site, existing facilities, as well as adjacent property. The Contractor shall be responsible for all damage or injury done to pipes, structures, utilities, pavement, buildings, property or person as a result of work to complete this contract. The Contractor at his own expense shall repair or replace such property or item to the satisfaction of the property owner, utility owner, public agency having jurisdiction, Architect/Engineer and Owner's Designated Representative.
- E. The Contractor's attention is directed to the fact that only designated personnel from the agency with jurisdiction over the existing water main may operate water valves along existing water mains. The Contractor shall be responsible to coordinate with each party.
- F. Prior to work at existing mains, the Contractor shall expose the existing water main and have available all labor, materials, and equipment necessary to complete the installation. The existing water main shall not be shut down until, in the opinion of the Architect/Engineer, the Contractor is ready to complete the work. The water main shall only be shut down during the period of time warranted for proper connection and only if a wet tap of the existing water main is not feasible.

- G. The Contractor shall coordinate with the Owner for any necessary water service shutdowns necessary to complete the work. The date, time and duration of any service shutdowns shall be mutually agreed upon prior to start of work. Refer to Part 1.2 of this specification.
- H. The Contractor's attention is directed to the fact that all work within the road rights-of-way including the installation of the curb stop (control valve) shall only be completed by designated personnel from the agency with jurisdiction over the existing water main. The Contractor shall be responsible to coordinate with the utility owner for scheduling and completion of the work required to complete work under this contract.
- I. The Contractor shall be solely responsible to coordinate with the appropriate Health Department to obtain water samples for testing. The Niagara County Health Department must receive at least 48 hours advance notification requesting sampling services.
- J. The Contractor shall be responsible to coordinate with MCWA to obtain bacteriological water samples and complete testing.
- K. Water line shall be installed in a separate trench from gas or electric utilities.

1.9 PROTECTION OF WATER AND GAS LINES FROM STORM AND SANITARY SEWER

- A. Parallel Water (or Gas) and Sewer Lines – Potable water (or gas) lines and pipelines carrying sewage, (including vaults, manholes or structures) shall not be installed any closer than 10 feet horizontally from one another. The distance shall be measured outside edge to outside edge of pipe or structure.
- B. Water (or Gas) and Sewer Line Crossings – Whenever water (or gas) and sewer lines must cross, the sewer must be situated below the water (or gas) line with at least an 18-inch clear, vertical separation between top of sewer line and bottom of water line. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water (or gas) line joints (at least one full laying length of water (or gas) pipe shall be centered over the sewer). In no case shall a water (or gas) line pass under a sewer unless specifically approved by the Architect/Engineer. Where a water (or gas) line is approved to cross under a sewer, adequate structural support (compacted select fill) shall be provided for the sewer to prevent excessive deflection of joints and settling of the sewer on the water (or gas) line.

PART 2 – PRODUCTS

2.1 MATERIALS – GENERAL

- A. Caps and Plugs: Watertight, of similar manufacturer and producing the same joint conditions as the pipe on which the cap or plug is placed.
- B. Foundation Materials:

1. Gravel or crushed stone bedding shall be as detailed on the Contract Drawings and as specified in Division 31 Section "Earth Moving."
 2. Select earth backfill shall be as detailed on the Contract Drawings and as specified in Division 31 Section "Earth Moving."
- C. Pipe Adapters: Join pipes of different materials with adapters specifically manufactured for that purpose and as approved by the Architect/Engineer. Where dissimilar materials join, such that galvanic action may produce corrosion, provide dielectric couplings to preclude damage to the materials.
- D. Concrete for Pipe Encasements and Cradles: Class A concrete per NYSDOT Standard Specification Section 501, except contain no fly ash.
- 2.2 DUCTILE IRON PIPE – MECHANICAL OR PUSH ON JOINT
- A. All ductile iron materials shall be manufactured in North America. All pipe and fittings shall be new, of good quality, strong, of even grain, and soft enough to permit drilling and cutting. Each pipe shall be free from any defects, which would make it unfit for the use intended. All pipe shall be straight, and a true circle in section with concentric inner and outer surfaces. Only gauged pipe will be allowed. Pipe to be cut during installation shall be fully gauged for field cutting. Pipe metal shall be made without any admixture of cinder iron or other inferior material.
- B. All joint hardware used on water mains, pipe fittings, and appurtenances shall be made of cold formed, high strength, low-alloy steel (Cor-ten), ASTM A242.
- C. Pipe shall be ductile iron pipe conforming to the latest requirements of ANSI A21.51 (AWWA C151). Pipe class thickness shall be Class 52.
- D. Fittings shall be compact ductile iron mechanical joint fittings conforming to the requirements of ANSI A21.53 (AWWA C153). Fittings shall equal or exceed the requirements of the main pipe and shall have a rated working pressure of 350 psi. No push-on fittings shall be allowed.
- E. All pipe and fittings shall be cement mortar lined (double thickness) with asphaltic seal coat conforming to ANSI A21.4 (AWWA C104).
- F. All pipe and fittings shall also be asphalt coated on the outside surface in accordance with ANSI A21.21 (AWWA C151) for pipe and ANSI 21.53 (AWWA C153) for compact fittings.
- G. Pipe joints shall be rubber gasket push-on, mechanical joint, or mechanical joint anchoring type. All pipe joints shall conform to the requirements of ANSI A21.11 (AWWA C111). Lead tipped gaskets shall not be allowed.
- H. Mechanical joint wedge action retainer glands for ductile iron pipe shall be manufactured according to ASTM A536. Set screws are to be heat treated AISI 4140 steel cup point with square head. Bolt pattern shall be compatible with standard mechanical joint fittings. Retainer

shall have fusion bonded epoxy coated body and glands. Retainer glands necessary to make proper connections between the mechanical joint fittings and push-on joint pipe shall be provided. Retainer glands shall be Megalug as manufactured by EBBA Iron Sales, Inc., Uni-flange as manufactured by Ford Meter Box Co., or approved equal.

- I. Gaskets shall be synthetic rubber for use with water supply applications. An adequate number of gaskets shall be furnished for the amount of fittings supplied.
- J. The manufacturer's mark, nominal diameter of openings, and the number of degrees or fraction of the circle on all bends, shall be distinctly cast on the fittings. The pressure rating shall be distinctly marked on the fittings. Ductile iron fittings shall have the letter "DI" or "Ductile" cast on them.
- K. Acceptable DIP pipe manufacturers include U.S. Pipe & Foundry, Clow Water Systems, Griffin Pipe Products or approved equal.

2.3 COPPER PIPE

- A. Tubing: seamless copper water tubing in accordance with ASTM B88 latest revision. For underground installation, soft annealed Type K. Furnish in straight lengths or coils as required.
- B. Type L Copper shall be used in above ground locations.
- C. Service fittings or couplings shall be compression type copper to copper, Mueller H-15403 as manufactured by Mueller Co. or approved equal.

2.4 POLYETHYLENE ENCASEMENT

- A. Polyethylene tube: ANSI/AWWA C105.
- B. Thickness: 8 mils.
- C. Pigmentation: Natural when exposure to ultraviolet light such as sun will be less than 48 hours. Pigmentation shall be 2.0 to 2.5% well-dispersed carbon black with stabilizers when exposure to ultraviolet light will be 2 to 10 days.
- D. Polyethylene: Virgin polyethylene produced from DuPont Alathon or USI Petrothene resins.
- E. Method of manufacture: Extruded tube form.
- F. Closure Tape: Polyhen #900 or Scotchrap #50, 2" wide, plastic backed, adhesive tape.

G. Flat tube widths:

Nominal Pipe Sizes	Push-On Flat Tube Width	Joint Width	Mechanical Tube Width	Flat
6"	16"		20"	
8"	20"		24"	
10"	24"		27"	
12"	27"		30"	
14"	30"		34"	
16"	34"		37"	
18"	37"		41"	
20"	41"		45"	
24"	54"		53"	

2.5 GATE VALVE – (Buried Service)

- A. Gate valves furnished shall have resilient seat construction with non-rising stems, standard 2 NPS square AWWA operating nut with cast-on directional arrow and shall open to the left. Valves shall be for buried service.
- B. Gate valves shall remain water tight under a test pressure of 300 psi. All valves shall meet or exceed all requirements of ANSI/AWWA C509 requirements for resilient seated valves. Valve stem seal shall be O-rings. The compound shall be Buna-N or NBR rubber and have a durometer hardness of 70 ± 5 when tested in accordance with ASTM D2240.
- C. Gate valves shall have mechanical joint end connections. Retainer glands shall be used on all valves.
- D. All external fasteners for the bonnet and stuffing box shall be made of stainless steel Type 304 or Type 316.
- E. All joint hardware shall be made of cold formed, high strength, low-alloy steel (Cor-ten), ASTM A242.
- F. Supply extension box and valve key.
- G. Gate valves (12 NPS or smaller) shall be Model A-2360-20 as manufactured by Mueller Co., Model Ken-Seal II Figure 4571x as manufactured by Kennedy Valve, Model A-USPO as manufactured by U.S. Pipe Valve & Hydrant Division, or approved equal.

2.6 TAPPING SLEEVE AND VALVE

- A. Tapping sleeves shall be ductile iron with a suitable coating conforming to the requirements of AWWA C110. Tapping sleeves shall have rubber gaskets and shall be

designed for working pressure of 200 psi. The sleeve shall be of a type that will lock in place.

- B. Tapping sleeves shall be Mueller or approved equal (24 NPS or less) with all necessary glands, gaskets and bolts with nuts compatible to tap ACP Water pipe. Sleeves shall be ordered to fit outside diameter of pipe being tapped.
- C. Tapping valves shall be gate valves with appropriate inlet and outlet flanges for attachment to tapping sleeve and drilling machine. Tapping valves shall conform to the requirements of AWWA C500, latest revision.
- D. All external fasteners for the bonnet and stuffing box shall be made of stainless steel Type 304 or Type 316.
- E. Tapping valves shall be manufactured by the Mueller Co., Kennedy Valve or approved equal and shall be appropriate for use with the approved tapping sleeve.
- F. Valves and sleeves shall include all hardware, glands, and gaskets.

2.7 WARNING TAPE

- A. Provide detectable warning tape. Refer to Division 31 Section "Earth Moving".

2.8 THRUST RESTRAINT

- A. Concrete used for thrust blocks, pipe cradles, and pipe encasements shall conform to the requirements for NYSDOT Class A concrete per Standard Specification Section 501 except contain no fly ash.

2.9 CONNECTIONS TO EXISTING PIPELINES

- A. Connect to existing main as shown on the Contract Drawings. Where no details of the connections are shown, submit a proposal for approval, showing fittings, adapters, and procedures used.

PART 3 – EXECUTION

3.1 PREPARATION

- A. The Contractor shall verify that points of connections to existing pipes have been excavated, elevations taken and given to the Architect/Engineer, and the Architect/Engineer has issued an authorization to proceed with the work as shown, or with modifications.

- B. Thoroughly clean interiors of pipes, fittings, and appurtenances, joint surfaces, and gaskets prior to installation. Maintain pipes and fittings clean.
- C. Verify that excavation is in the proper location, that pipes and structures have been installed at the correct elevations and that the sub-grade has been properly prepared.

3.2 PIPE INSTALLATION - GENERAL

- A. Install water lines to the required lines and grades indicated on the Drawings or as directed by the Architect/Engineer using an approved method of control. The location, lines, and depths of the pipelines, valves, and other appurtenances shown are approximate only; actual locations, lines, and depth shall be as directed by the Architect/Engineer at the time of installation.
- B. For underground piping, the trench shall be excavated to the required alignment and width, and to a depth that will assure the minimum cover over the top of the water main pipe after construction has been completed. Excavation and backfilling shall conform to the requirements of Division 31 Section "Earth Moving". The Contractor shall dewater the trench and keep it free of water at all times.
- C. Pipe and fittings shall be installed in accordance with the requirements of ANSI/AWWA C-600 for ductile iron pipe according to manufacturer's latest instructions and as approved by the Architect/Engineer.
- D. Carefully lower pipes, fittings, and structures into the trench. Apply joint lubricant (if required) in accordance with the approved manufacturer's recommendations. Join pipe sections and fittings. Join pipe and structures.
- E. Select pipe and fittings so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. Pipe and fittings, which do not fit together to form a tight fitting joint, are not permitted.
- F. Use only mechanical cutters for cutting pipe.
- G. Maintain cleanliness of installed pipe, fittings, and structure interiors throughout the work. Plug ends when installation is not in progress so that dirt, foreign matter, water, animals, and people do not enter the work. Drainage of construction excavations through installed pipes shall not be permitted.
- H. Maintain the excavation free of water during the progress of the work. No pipes or structures shall be laid in water nor shall there be any joints made up in water. No separate allowance for pumping or otherwise removing water will be made. All slides or cave-ins of the trenches or cuts shall be remedied at the expense of the Contractor, and to the satisfaction of the Architect/Engineer.

- I. Dead ended lines shall be fitted with approved watertight plugs or caps specially manufactured for that purpose.
- J. The Engineer may inspect each stretch of completed pipeline and structure prior to backfilling. The Contractor shall not continue with backfilling operations prior to inspection by the Architect/Engineer and utility representatives.
- K. When unsuitable materials and/or conditions are encountered, the Architect/Engineer may direct the excavation to continue below grade and the trench filled with gravel or crushed stone foundation, or the Architect/Engineer may order other corrective measures.
- L. Detectable warning tape shall be placed in the open trench (above the water main or service) at a depth as shown on the Contract Drawings. The tape shall run continuously along the centerline of the water main or service, with wording facing up.
- M. All pipes shall be polyethylene encased. Cut polyethylene tubing in lengths which are 2 feet longer than pipe section and place around pipe. After pipe joint has been made, overlap joint with polyethylene tube and secure in place with closure tape. Fold tube over at top and secure at quarter points along pipe section. Remove and replace all damaged tube.

3.3 ANCHORING PRESSURE PIPES

- A. All fittings (e.g. tees, bends, offsets, plugs etc.) shall be solidly braced to prevent any movement due to thrust pressure. Bracing shall be accomplished with the use of cast-in-place concrete between the fittings and undisturbed soil. Thrust block dimensions shall be as shown on the detail drawings. Thrust blocks are not required at hydrant base elbows. All fittings shall require mechanical restraint (e.g. mechanical retainer glands, etc) in addition to concrete thrust blocks. Appropriate materials and installation methods shall be used for mechanically restrained joints.

3.4 CONNECTION TO EXISTING PIPELINES

- A. Connect to existing pipelines in accordance with the Drawings, or as directed by the Architect/Engineer. Provide necessary adapters and specials required to make the connections.
- B. Do work at such times and in such a manner as to cause a minimum of interruption to existing services. Services damaged by work under this Contract shall be repaired immediately at no additional cost to the Owner.
- C. Prior to installing a tapping sleeve and valve or an insertion valve, the Contractor shall carefully expose the existing main. Prior to making the tap the Contractor shall test the installation for leakage in the presence of the Architect/Engineer. Equipment for pressure taps shall be valved and gasketed to prevent leakage during the tapping.

- D. All pipe shall be cut by an approved power saw which will produce a clean, true cut, with a smooth end at right angles to the axis of the pipe. All cut ends shall be beveled.
- E. Taps utilizing corporation stops shall be completed with a service saddle.

3.5 GENERAL INSTALLATION - APPURTENANCES

- A. Valves, and appurtenances shall be stored under cover and kept drained of water.
- B. Valves shall be installed with their operating stems in a vertical position. Bedding under valves shall be well compacted and firm. Concrete support blocks shall be level.
- C. Buried valves shall have post indicators, valve boxes or curb boxes installed centered and vertical over the valve or curb stop. The Contractor shall brace all boxes to ensure they remain in a vertical position after backfilling. The upper section of the boxes shall be adjusted to finished grade or as directed by the Architect/Engineer.
- D. After trench backfilling has been made and allowed to consolidate, the valves, curb stops, post indicators, valve boxes and curb boxes shall be checked for vertical setting and shall be reset if found out of line.
- E. The Contractor is responsible for maintaining and keeping valves, valve boxes, curb stops, curb boxes, and all appurtenances clean, free of debris and in the proper alignment until completion of the Contract.
- F. All valves shall be joined to the pipeline with mechanical joints.
- G. When installation and clean up are complete, Contractor shall remove all loose scale and foreign matter on the hydrant and paint all new or relocated hydrants per the requirements of the authority having jurisdiction. Hydrants shall be coated with two coats of rust-resisting tar below grade.
- H. Upon completion of the project, all valve wrenches shall be turned over to the Owner.

3.6 TESTING OF WATER MAINS

- A. All water services 4-inches and larger shall be tested as water main.
- B. The Contractor shall conduct a pressure test of the water main after all appurtenances required in the work for the section to be tested are installed. The length of section to be tested shall be approved by the Architect/Engineer. Whenever conditions permit, as determined by the Architect/Engineer, the water main shall be tested before the trench is backfilled. The pressure test shall be witnessed by the Architect/Engineer or his designated representative.

- C. The pressure test shall be done in accordance with the requirements of Section 4 of ANSI/AWWA C600 for ductile iron pipe. Prior to the test, the Contractor shall submit the proposed testing methods and equipment, in writing, for the Architect/Engineer's approval. Testing equipment shall be approved by and calibrated to the satisfaction of the Architect/Engineer. The Contractor shall furnish all pumps, meters, plugs, caps or other necessary equipment to conduct the test.
- D. The section of pipe to be tested shall be filled with water of potable quality and all air shall be expelled from the pipe. The Contractor shall make all taps, as necessary, for releasing all of the air and for all test purposes as may be required. Taps may be installed during the laying of the water main.
- E. For the pressure test, the Contractor shall raise the water pressure (based on the elevation at the lowest point in the section under test and corrected to the gauge location) to a minimum pressure of 150 pounds per square inch gauge for domestic water mains.
- F. The required pressure shall be maintained for an uninterrupted period of two hours. Unless otherwise noted, the volume of water required to maintain the specified pressure as measured by the Architect/Engineer shall not exceed the limits determined by the following formula as defined in Section 4 of ANSI/AWWA C600:
$$L = \frac{SD \sqrt{P}}{133,200}$$

in which L is the allowable leakage in gallons per hour; S is the length of water line tested; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test in pounds per square inch gauge.
- G. If a section should fail to pass the pressure test, the Contractor shall do everything necessary to locate, uncover, and replace any defective material or work of the newly installed pipe to the satisfaction of the Architect/Engineer, at his own expense and without extension of time for completion of the Work. Repeated tests and repairs shall be made until the section passes the specified tests. Should the defect not be a result of work associated with the project, the Contractor shall bring this to the attention of the Owner.

3.7 DISINFECTION OF WATER LINES/WATER SERVICES

- A. Tapping sleeves & valve and insertion valves: All parts of the tapping equipment which will come in contact with the water on the existing main shall be washed in a chlorine solution before using.
- B. Cut-in Valves: All parts of the equipment or materials exposed to the existing main, as well as the exposed existing main shall be washed in a chlorine solution before using.
- C. Valves, curb stops, corporation stops, and hydrants shall be tested prior to backfilling in accordance with specifications below. All valves shall be operated during the testing and disinfection.

- D. After a section of water main has been pressure tested and found acceptable, it shall be thoroughly flushed by the Contractor. Minimum flushing velocity shall be 2.5 feet per second.
1. Flows to produce a minimum velocity of 2.5 feet per second:

Pipe Size (Inches)	Flow (gpm)	Hydrant Openings @ 40 psi
4	100	one - 2-1/2"
6	220	one - 2-1/2"
8	390	one - 2-1/2"
10	610	one - 2-1/2"
12	880	one - 2-1/2"
16	1,570	two - 2-1/2"

- E. Upon completion of flushing, the Contractor shall disinfect the main, services, valves, and hydrants with chlorine solution in accordance with the requirements of AWWA C651 (Item 5.1 deleted) using the continuous feed method. The strength of this solution shall be such that a residual of at least twenty-five (25) mg/l of chlorine shall be retained in the main after twenty-four (24) hours.
- F. The interiors of all appurtenances and sections of water main that cannot be normally disinfected shall be swabbed by the Contractor to the satisfaction of the Architect/Engineer with a concentrated chlorine solution containing not less than 200 ppm of free chlorine before installation.
- G. Disinfect all existing water lines, services, and appurtenances, which were broken, damaged, contaminated, or suspected of being contaminated as a result of work done in conjunction with this project.
- H. Following disinfection, all treated water shall be thoroughly flushed from the main (minimum flushing velocity 2.5 feet per second) and samples shall be taken and analyzed by the Niagara County Department of Health. The main shall not be placed in service until the water has been approved for service and a copy of the approval from the Niagara County Health Department and Niagara County Water Authority has been received by the Architect/Engineer, Owner.
- I. If the tests results are unsatisfactory, additional flushing shall be done by the Contractor or the main shall be re-chlorinated, or both until further testing indicates the results are satisfactory.
- J. All testing shall be at the Contractor's expense.

3.8 FIELD QUALITY CONTROL

- A. In the presence of the Architect/Engineer inspect each length of pipe and each structure delivered to the job for flaws, cracks, dimensional tolerance and compliance with the applicable specifications. Only pipes, fittings and structures accepted by the Architect/Engineer and so

marked shall be installed in the work. Segments of polyethylene tubing having cuts or gouges in excess of 10% shall be cut out and removed. Undamaged portions shall be rejoined.

- B. The Contractor shall inspect pipe joints and verify that they have been properly installed and made up, and free from sags, high spots, and excessive deflections.

3.9 DAMAGED FACILITIES

- A. Any section of piping that is found defective in material, alignment, grade, joint, or otherwise, shall be corrected at no additional cost to the Owner.
- B. In the event that dirt, debris, or any other foreign material has entered any portion of the piping or structures, flush the piping or structure with clean water. Continue the flushing process until the piping or structure is clean, as determined by Architect/Engineer.
- C. Any damage done to existing utility mains their appurtenances as result of work under this contract shall be repaired or replaced by the Contractor to the satisfaction of the Architect/Engineer at no additional cost to the Owner.

END OF SECTION 331116

SECTION 333116 – SITE WASTE UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section covers the installation of sanitary sewers/laterals and appurtenances complete, with related and incidental work, as shown on the Contract Drawings and as required to complete the project.
- B. The Contractor shall research and determine what permits, fees, and approvals are required from municipal agencies and shall secure those permits and pay appropriate fees prior to beginning construction work required by this section.
- C. Contractor shall be responsible to maintain flow through existing sanitary sewer systems by whatever means necessary, including pumping, temporary piping etc. Contractor shall coordinate with the Architect/Engineer for approval of proposed methods.
- D. Related Sections:
 - 1. Division 31 Section **“Earth Moving”**
 - 2. Division 32 Section **“Turf and Grasses”**

1.3 QUALITY ASSURANCE

- A. All work related to the sanitary sewer system shall be completed in accordance with the requirements of Seneca Nation.
- B. All castings shall each be the product of a single manufacturer who can furnish evidence of satisfactory experience in the product of high quality products of the type indicated and specified.
- C. Pipe and pipe fittings shall be produced in a plant of recognized reputation that is regularly engaged in the production of pipe conforming to the specified standards. Pipe and pipe fittings of the same type shall be the product of a single manufacturer.
- D. All pipe and pipe fittings, and castings shall be of good quality and free from defects which would make it unfit for the use intended.
- E. Contractor shall be responsible for furnishing all labor, materials, surveying instruments and tools necessary to establish and maintain all lines and grades.

1.4 SUBMITTALS

- A. Shop drawings, catalog cuts, and manufacturer's literature for all pipe and pipe fittings, to include coatings and linings, material specifications, dimensions, tolerances, and all related data shall be submitted.
- B. Manufacturer's certification that pipe supplied meets the required specifications shall be submitted.
- C. Pipe manufacturers shall furnish Certificates of Compliance on pipe, with each load of pipe supplied. Immediately turn certificates over to Architect/Engineer. Materials delivered to the site without accompanying certificates will be subject to rejection.
- D. Shop drawings showing proposed methods and procedures for connecting to existing pipelines shall be submitted to the Architect/Engineer for approval.
- E. Shop drawings and catalog cuts of adapters for the joining of pipes of different materials and for caps and plugs at ends of pipelines shall be submitted.
- F. Submit record drawings indicating actual location of pipe runs, connections, wyes, stubs, structures and associated invert elevations. Record actual vertical separations at all exposed utility crossings. Record invert elevations at all utility crossings.
- G. Submit detailed plan on handling of bypass flows during construction including equipment and methods proposed, timeline, crews and contingency plan. This plan will be reviewed by the Architect/Engineer and no bypass operations will be permitted without an approved plan.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Each length of pipe delivered to the site shall be clearly marked at the factory with the name of the manufacturer, class of pipe, pipe diameter and all else as required by the codes, standards, and specifications referred to under this section. Omission of this information will be cause of rejection of pipe.
- B. Store all materials in accordance with manufacturer's approved instructions. Store all materials so they can be easily inspected and they will not be damaged prior to installation. Store PVC pipe under canvas or other opaque material, which will allow air circulation but will eliminate the direct rays from the sun.
- C. Carefully handle all pipes and fittings when loading and unloading to avoid damage to pipe, coatings, or linings. Pipe or fittings with damaged coatings or linings shall be repaired or replaced by the Contractor at his expense, and to the satisfaction of the Architect/Engineer. Lift pipes and fittings by hoists or lower on skid ways in a manner to avoid shock. Lower pipe into trench with derricks, rope, or suitable equipment for the safety and protection of workmen, materials, equipment, property, and the work.
- D. Do not dump or drop pipe and fittings. Those that are dumped or dropped are subject to rejection by Architect/Engineer.

- E. Carefully handle all castings when loading and unloading to avoid damage. In the event of damage, either in delivery or installation, the damaged castings shall be immediately removed from the project site and replaced at no additional cost to the Owner.

1.6 ABBREVIATIONS

CIP	Cast Iron Pipe
DIP	Ductile Iron Pipe
PVC	Polyvinyl Chloride Pipe
RCP	Reinforced Concrete Pipe

1.7 JOB CONDITIONS

- A. The drawings indicate the required structure and pipe sizes, and locations of all structures, piping and appurtenances. Verify all locations and immediately notify Architect/Engineer of any discrepancies or conflicts.
- B. Contractor shall verify that survey benchmark and intended elevations for the work are as indicated. Contractor shall verify existing site conditions.
- C. Utilities shown on the Contract Drawings are for the convenience of the Contractor, exact locations are not guaranteed. The Contractor shall verify existing utilities with the proper authorities.
- D. The Contractor shall take precautions to protect from harm the work of other contractors on site, existing facilities, as well as adjacent property. The Contractor shall be responsible for all damage or injury done to pipes, structures, utilities, pavement, buildings, property or person as a result of work to complete this contract. The Contractor at his own expense shall repair or replace such property or item to the satisfaction of the property owner, utility owner, public agency having jurisdiction, Architect/Engineer and Owner's Designated Representative.
- E. The Contractor shall coordinate with the Owner for any necessary sanitary sewer service shutdowns necessary to complete the work. The date, time and duration of any service shutdowns shall be mutually agreed upon between the Contractor, Owner's designated Representative, and Architect/Engineer, prior to start of work.

1.8 PROTECTION OF WATER AND GAS LINES FROM SANITARY

- A. Parallel Water (or Gas) and Sewer Lines – Potable water (or gas) lines and pipelines carrying sewage, (including vaults, manholes or structures) shall not be installed any closer than 10 feet horizontally from one another. The distance shall be measured outside edge to outside edge of pipe or structure.
- B. Water (or Gas) and Sewer Line Crossings – Whenever water (or gas) and sewer lines must cross, the sewer must be situated below the water (or gas) line with at least an 18-inch clear, vertical separation between top of sewer line and bottom of water line. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water (or gas) line joints

(at least one full laying length of water (or gas) pipe shall be centered over the sewer). In no case shall a water (or gas) line pass under a sewer unless specifically approved by the Architect/Engineer. Where a water (or gas) line is approved to cross under a sewer, adequate structural support (compacted select fill) shall be provided for the sewer to prevent excessive deflection of joints and settling of the sewer on the water (or gas) line.

- C. Special Conditions – When it is not practical to maintain a 10-foot horizontal separation between sewer and water (or gas) lines, immediately notify the Architect/Engineer. If the Architect/Engineer concurs, the utilities shall be installed as follows:
1. For water (or gas) lines that pass over sewers: the water (or gas) line shall be installed as far away from the sewer as possible with a minimum horizontal separation of 3 feet and a minimum of 6-inches above the sewer, as measured from the invert of the water (or gas) line to the crown of the sewer.
 2. For water (or gas) lines installed below sewers: the water (or gas) line shall be installed 18-inches below the invert of the sewer or by one of the following as approved by the Architect/Engineer with a variance obtained from the appropriate Department of Health office:
 - a. Construct the sewer using water main standard pipe and testing said pipe at 150 psi, or
 - b. Encase, sleeve, or otherwise envelope the water main or sewer to maximize protection of the water main.
- D. Special Conditions – Crossing Lines – When it is impossible to obtain proper vertical separation, immediately notify the Architect/Engineer. If the Architect/Engineer concurs, the utilities shall be installed as follows:
- 1 For water (or gas) lines that pass over sewers: If 18-inches of vertical separation is not feasible and the vertical separation is between 6- and 18-inches, all water (or gas) line joints within 20 feet of the sewer shall be encased in control density fill.
 - 2 For water (or gas) line that pass below sewers: If 18-inches of vertical separation is not feasible one of the following shall be completed as approved by the Architect/Engineer with a variance obtained from the appropriate Department of Health office:
 - a. Construct the sewer using water main standard pipe and testing said pipe at 150 psi, or
 - b. Encase, sleeve, or otherwise envelope the water main or sewer for a distance equal to two full lengths of water pipe to maximize separation between the crossing and unprotected joint.

PART 2 – PRODUCTS

2.1 MATERIALS – GENERAL

- A. Caps and Plugs: Water tight, of similar manufacturer and producing the same joint conditions as the pipe on which the cap or plug is placed.

- B. Foundation Materials:
1. Gravel or crushed stone bedding shall be as detailed on the Contract Drawings and as specified in Division 31 Section "Earth Moving".
 2. Select earth backfill shall be as detailed on the Contract Drawings and as specified in Division 31 Section "Earth Moving".
- C. Pipe Adapters: Join pipes of different materials with adapters specifically manufactured for that purpose and as approved by the Architect/Engineer. Where dissimilar materials join, such that galvanic action may produce corrosion provide dielectric couplings to preclude damage to the materials.
- D. Concrete for Pipe Encasements and Cradles: Class A concrete per NYSDOT Standard Specification Section 501.
- 2.2 POLYVINYL CHLORIDE PIPE (PVC) BURIED Non-Pressure Piping (Gravity Sanitary Sewer)
- A. Pipe and Pipe Fittings
1. Acceptable Products – As manufactured by Certainteed Johns-Mansville, Clow Corp., or approved equal.
 2. Materials – PVC pipe and fittings to be used for gravity sewer shall fully conform to the requirements of ASTM D3034 "Type PSM polyvinyl chloride (PVC) sewer pipe and fittings," latest revision. Pipe and fittings shall also meet or exceed the requirements of Uni-Bell UNI-B-5 recommended standard for integral, gasketed joint PVC sewer pipe and fittings. Standard diameter ratios (SDR) 35 pipe shall be provided unless otherwise noted on the Contract Drawings.
 3. The pipe and pipe fittings shall also be made of PVC plastic having a cell classification of 12454-B, or 12454-C, or 13364-B as defined in ASTM D1784.
 4. Standard laying length shall be 20 feet. Random lengths of less than 20 feet may be utilized to make proper connections as approved by the Architect/Engineer.
- B. Joints
1. The pipe shall be joined with an integral bell, bell and spigot type rubber gasketed joint. Each integral bell joint shall consist of a formed bell complete with one or more rubber gaskets. Gaskets shall conform to ASTM F477. The gasket shall be locked securely in place by a groove formed in the bell to prevent displacement during assembly. The "locked-in" rubber seating ring shall also meet or exceed the requirements of ASTM D3212 – Joints for Drain and Sewer Pipes Using Flexible Elastomeric Seals. Pipe with gaskets held in place by only glue will not be acceptable unless approved otherwise by the Architect/Engineer.
 2. Each spigot end shall be clearly marked, for the entire circumference, indicating the proper distance of insertion into the adjoining bell end, such marking being placed so as to adequately allow for expansion and contraction of the pipeline over the full range of temperature fluctuations which may occur in the final installation. The sealing ring shall

be the only element depended on to make the joint flexible and water tight.

3. Joint lubricant shall be as recommended by the manufacturer

2.3 CLEANOUTS

- A. Fabricate clean out riser from Extra Heavy Cast Iron Soil Pipe (ASTM A74), PVC Schedule 40 or PVC SDR 21 pipe as described above. Provide brass screw plug.
- B. Joints of clean out riser shall be glued.
- C. Frames and covers for clean out inspection ports shall be cast iron with blind pick hole meeting ASTM A48 Class 30 or better. The top surface shall have a non-skid surface and shall bear the title "SEWER." The frame and covers shall be as manufactured by Syracuse Castings Model 4155, or approved equal.

2.4 PIPE CONNECTIONS

- A. For repair of short sections of existing sanitary sewer pipe, the connections between existing and new sewer pipe shall be made using the following couplings:
 1. Male end of New Sewer Pipe to Female End of Existing Pipe:
Donut style by General Engineering Company, Box 609, Frederick, Maryland 21701; Pomona Pipe Products; or equal.
 2. Male End of New Sewer Pipe to Male End of Existing Pipe:
Fernco Flexible Couplings by General Engineering Company, Box 609, Frederick, Maryland 21701; Dresser Model 360 "All-Around" Pipe Repair Clamps in Stainless Steel; or equal.
- B. Lateral connections on new sanitary sewer main installation shall be made with a wye fabricated or injection molded fittings. The minimum strength classifications of these fittings shall be equal to that of the pipe and the fitting shall be compatible with the pipe.
- C. Lateral connections to existing sewer shall be made with GENCO "Sealtight" strap-on saddles with double stainless steel straps and stainless steel or bronze bolts for sewers up to 14 inches in diameter and GENCO bolt-on saddles for sewers greater than 14 inches in diameter, or approved equal.
- D. All lateral connections to mains shall be separated by a minimum of 10 feet.

2.5 DETECTABLE UNDERGROUND MARKING TAPE

- A. For all PVC pipe, provide detectable warning tape. Refer to Division 31 Section "Earth Moving".

PART 3 – EXECUTION

3.1 PIPE PREPARATION – GENERAL

- A. Pipe, fittings, and appurtenances shall be inspected before they are lowered into trench. Interior of pipe and joint surfaces shall be thoroughly cleaned and shall be maintained clean. Open end of pipeline shall be securely plugged whenever pipe laying is not in progress.
- B. Pipe and fittings, which do not fit together to form a tight joint, shall be rejected. Pipe and fittings shall be selected so that there will be as small a deviation as possible at joints so that the interior presents a smooth surface.
- C. Pipe cutting shall be done with sharp tools in such a manner that it will not crack the pipe away from the cut, using methods approved by pipe manufacturer. Any pipe entering a manhole shall be neatly cut with proper sharp tools before installation in the manhole. Pipe shall not be “chipped off” after installation.
- D. Pipeline bedding shall be in accordance with Division 31 Section “Earth Moving” and as shown on the plans.
- E. The pipe fittings and specials shall be installed to the required line and grade, and shall be firmly bedded in the trench so the pipe barrel is uniformly supported and cradled. All pipes shall fit together to form a smooth, even invert.
- F. After pipe is laid and adjusted to its final position, bed shall be repaired where disturbed by laying operation, and joint holes filled. Any gaps in bed shall be filled by placing bedding material under bottom and haunches of pipe so pipe is supported for its full length and is tightly held in position.
- G. Pipe shall be installed so that a pipe joint occurs not more than 2 feet from the outside of the wall or manhole or structure to which the pipe connects.
- H. Pipe shall be laid from the downstream end upgrade with spigots placed in the direction of flow. All pipes shall be laid to the line and grade shown on the plan unless otherwise directed. Connections to existing manholes or pipe stubs shall be made to the satisfaction of the Architect/Engineer.
- I. No pipe shall be laid in water or when weather and trench conditions are unsuitable for pipe laying, unless permission has been obtained from the Architect/Engineer.
- J. Maintain cleanliness of installed pipe, fittings, and structure interiors throughout the work. Plug ends when installation is not in progress so that dirt, foreign matter, water, animals, and people do not enter the work. Drainage of construction excavations through installed pipes shall not be permitted.
- K. Jointing shall be accomplished in strict accordance with manufacturer’s recommendations. Lubricant used at the joint shall be water soluble, non-toxic, non-supporting of bacteria growth and have no deteriorating effects on the pipes or gaskets. Solvent for pipe jointing shall be as recommended by the manufacturer of the pipe.
- L. Push-on joints shall be assembled in full accordance with the manufacturer’s instructions and the following procedures:

1. The inside of the bell and spigot ends of the pipe to be joined shall be cleaned and washed thoroughly with soapy water until free from sand, dirt, and foreign material.
2. The joint gasket shall be inserted in the bell with the groove over the head in the bell gasket seat.
3. A film of special lubricant shall be applied to the entire gasket face on the inside of the bell.
4. The spigot end of the joining pipe shall be set in the bell until the spigot touches the gasket.
5. The pipe shall be pushed or jacked in to the bell only as far as the reference marks provided on the spigot indicate.
6. All defective push-on joints shall be reassembled and the defective material shall be discarded.

3.2 TREES AND OBSTRUCTIONS

- A. Where obstructions are encountered such as trees, drainage structures, and utilities, tunneling will be required.
- B. Where a utility or drainage structure is encountered, the Contractor shall stop ditching and tunnel. Care shall be taken to provide adequate shoring and support to the obstruction.
- C. When roots 1 inch or larger are encountered, within protection zones stop open ditching and tunnel. Especially important with evergreens with shallow root system. Protect trees in accordance with Division 31 Section "Site Clearing."
- D. Payment for tunneling shall be included in the price bid.

3.3 LINES AND GRADES

- A. Pipes shall be laid to the lines and grades shown on the Contract Drawings and shall be straight between manholes. The grade of the sewer between manholes and from pipe length to pipe length shall not vary from the design grade shown on the Contract Drawings by more than 0.15 times the design grade, unless a change in grade has been ordered by the Architect/Engineer, in which case the same tolerance shall apply. In addition, invert elevations at any location shall not vary from the design elevations by more than 0.05 feet, unless a change in invert elevation has been ordered by the Architect/Engineer, in which case the same tolerance shall apply. Any sewer grade or invert elevation which exceeds these tolerances shall be corrected by the Contractor at his own expense in a manner prescribed, and to the extent ordered by the Architect/Engineer.
- B. The method used to install the sewer shall be consistent with standard practice if establishing line and grade, and is sufficiently accurate to insure that the above requirements are met. Where replacing short sections of existing sewer of length less than distance of manhole to manhole, the Contractor shall verify, by exploratory excavation, the existing location and grade at each end of the section to be replaced and employ methods, such as transit and level, to install the new sewer true line and grade within the prescribed tolerances. The final alignment of the sewer shall be such that a clear and unobstructed line of sight exists between manholes.
- C. In the event the Contractor uses laser beam method to establish line and grade, the Contractor

shall check the grade of pipe at not more than 50-foot intervals by use of level instrument and tripod.

- D. The Contractor shall furnish all labor, materials, surveying instruments, and tools to establish and maintain all lines and grades. The Contractor shall have personnel on duty or on standby call, at all times who are qualified to set and check grades of sewers and manholes as they are installed.

3.4 TESTING OF SANITARY SEWERS AND APPURTENANCES

- A. Upon completion of construction of the sanitary sewer, including trench backfill, the Contractor shall clean and flush all pipes. All water needed to flush the sewer system shall be furnished by the Contractor at no additional cost to the Owner. The system shall be left free of all stones, sand, silt, or mortar projects. The benches and inverts of manholes and bottoms of inlets shall have all mortar dropping chipped away to leave a smooth, clean surface.
- B. All materials flushed from the sanitary sewer shall be intercepted and removed to prevent the materials from entering the existing sanitary sewer system.
- C. The Contractor shall supply all materials, equipment, and labor as required or ordered by the Architect/Engineer, to test the gravity mains, manholes, and appurtenances in accordance with the provisions of these specifications.
- D. The Contractor shall receive no additional compensation for making the leakage tests or corrective work necessary to reduce leakage below the maximum allowed by these Specifications or Division 33 Section "Precast Manholes".
- E. The Contractor shall be responsible to dewater the sewer and bypass sewage flow where necessary to complete testing.
- F. The Contractor shall leakage test each installed facility. These tests shall be conducted in the presence of the Architect/Engineer or his designated representative. No test will be accepted unless witnessed by the Architect/Engineer or his designated representative. Records and data of these tests shall be submitted by the Contractor to the Owner's Designated Representative as part of the record drawing information.
- G. Water used by the Contractor during any testing procedures will be paid by the Contractor. All hydrants for water supply for testing use shall be operated by the appropriate utility owner. Backflow preventer and meters for the hydrants shall be required and provided by the Contractor.

3.5 DISPLACEMENT TEST OF GRAVITY SEWERS

- A. Sewers will be checked by the Contractor in the presence of Architect/Engineer or his designated representative to determine whether any displacement of the pipe has occurred. The test will be as follows:
1. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system.

2. No pipe shall exceed a deflection of 5 percent.
3. Deflection tests are to be run using a rigid ball or mandrel, having a diameter of not less than 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.
4. If deflection exceeds 5 percent, replacement of the defective sewer will be required at no additional cost to the Owner.

3.6 LEAKAGE AND LEAKAGE TESTS OF GRAVITY SEWERS

A. General

1. Test section shall be no greater than 400 feet in length.
2. The tests for water tightness shall be made by the Contractor under the directions of the Architect/Engineer. The Contractor shall furnish, at his own expense, the necessary facilities for making the tests and determining groundwater conditions at the time of the test.
3. The Architect/Engineer will give the Contractor notice of the time and place when such tests will be made, which may be during a rainy season or period of high groundwater.
4. Hydrostatic-exfiltration and infiltration tests shall be conducted for a minimum test period of 24 hours. The Architect/Engineer may, at his discretion, require that the test period be extended beyond 24 hours in order to obtain meaningful test results.

B. Exfiltration (Gravity Sewer Lines)

1. Where no groundwater exists at the time of the tests, the sewers, manholes, and service connections shall be subjected to an internal water pressure test to the extent deemed necessary by the Architect/Engineer to determine their water tightness.
2. The lower end of the section shall be tightly plugged and the line filled with water. The line shall be vented to allow the air to escape from the pipe and the water level shall be brought to a point 2 feet above the crown of the pipe at its upper end shall be maintained for at least 1 hour. If deemed necessary by the Architect/Engineer, internal pressure tests will be made before backfilling of the section under test. Each joint and manhole will be inspected and any visible leakage shall be stopped by means satisfactory to the Architect/Engineer.

C. Infiltration (Gravity Sewer Lines)

1. Infiltration test shall be made in groundwater conditions as a check for water tightness of the sewers after backfilling has been completed and sufficient time has elapsed to permit the groundwater to rise to its normal level.
2. The test shall be made by using approved low head measuring weirs placed at the lower ends of the sections to be tested or by other approved methods. The Contractor shall

erect a temporary bulkhead to shut off flow from above the section being tested, and shall provide pumps downstream of the measuring device to keep the system drained for the period of the test. The measurement of the water entering the section under this test will be made over a period of time established by the Architect/Engineer.

D. Allowable Leakage Infiltration (Gravity Sewer Lines)

1. The maximum allowable leakage into the sewer lines including appurtenances shall be 100 gallons/mile/24 hours per 1 inch of internal diameter of the sewer. The maximum allowable infiltration expressed in gallons per hour is shown in Table B-1.

TABLE B-1
ALLOWABLE LIMITS OF INFILTRATION
BASED ON 100/GALLONS/INCH DIAMETER/MILE

<u>Diameter of Sewer Inches</u>	<u>Infiltration Per Foot Per Hour Gallons</u>	<u>Diameter of Sewer Inches</u>	<u>Infiltration Per Foot Per Hour Gallons</u>
4	0.0031	21	0.0166
6	0.0047	24	0.0189
8	0.0063	27	0.0213
10	0.0079	30	0.0237
12	0.0095	36	0.0284
15	0.0118	42	0.0331
18	0.0142	48	0.0379

2. Any section of sewer piping which does not meet the specified leakage test shall be repaired and retested by the Contractor at his expense.

E. Low Pressure Air Acceptance Test (Gravity Sewer Lines)

1. All branch fittings and ends shall be securely plugged to withstand the internal test pressures. The section of line being tested shall also be securely plugged at each manhole. All stoppers shall be adequately branched when required.
2. Air pressure tests shall be run following the guidelines of UNI-Bel (UNI-B-6-79) "Recommended Practice: For Low Pressure Air Testing of Installed Sewer Pipe."
3. General guidelines for air testing are provided. After a manhole to manhole reach of pipe has been backfilled to final grade, prepared for testing, and the specified waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.
 - a. It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing. It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line.

- b. This is particularly important in high groundwater situations.
- c. When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug, and thus not revealed by the air test.
- d. Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater above the pipe, but not greater than 9.0 psig. If groundwater is present, an air pressure correction must be made to the normal initial test pressure. This may be accomplished by dividing the vertical height (in feet) of the groundwater above the pipe invert by 2.31. This value is added to the initial test starting pressure. The allowable pressure drop and duration of the test are not affected by this adjustment.
- e. After a constant pressure of 4.0 psig (greater than the average groundwater back pressure), is reached, the air supply shall be throttled to maintain that internal pressure for at least two minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.
- f. When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater back pressure), the air hose from the control panel to the air supply shall be shut off or discontinued. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average back pressure of any groundwater over the pipe). At a reading of 3.5 psig, or any convenient observed pressure reading between 3.5 psig and 4.0 psig (greater than the average groundwater back pressure), timing shall commence with a stopwatch or other timing device that is at least 99.8 percent accurate.
- g. A predetermined required time for a specified pressure drop shall be used to determine the lines acceptability. A pressure drop of 1.0 psig is specified in accordance with Table B-2.
- h. If the time shown in Table B-2 for the designated pipe size and length elapses before the air pressure drops 1.0 psig, the section undergoing tests shall be passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even though the 1.0 psig drop has not occurred. If the pressure drops 1.0 psig before the appropriate time shown in Table B-2 has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.
- i. If the section fails to meet these requirements, the Contractor shall determine at his own expense the source, or sources of leakage, and he shall repair or replace all defective materials and/or workmanship to the satisfaction of the Architect/Engineer. The extent and type of repair, which may be allowed, as well as results, shall be subject to the approval of the Architect/Engineer. The completed pipe installation shall then be retested and required to meet the requirements of this test.

TABLE B-2

SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP

FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min./sec.)	3 Length for Minimum Time (ft.)	4 Time for Longer Length (sec.)	Specification Time for Length (L) Shown (min./sec)								
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	
4	3:46	597	.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:49	172:22	193:55	193:55
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	230:46

3.7 MANHOLE TESTING

- A. Leakage testing for sanitary manholes shall be performed in accordance with Division 33 Section "Precast Manholes".

3.8 CLEAN OUTS

- A. The Contractor shall furnish and install various clean outs as shown on the Contract Drawings and specified herein. Distance between clean outs shall not exceed 90 feet.
- B. The Contractor shall furnish and install necessary materials to complete the installation as shown. All pipe joints in clean outs shall be glued to prevent "spinning" of clean out when attempting to unscrew the threaded cap.

3.9 ABANDONMENT OF SEWERS AND APPURTENANCES

- A. When the new sanitary sewer has successfully passed the specified testing and has been placed in service, the existing sanitary sewer to limits shown on the Contract Drawings is to be abandoned.
- B. Sewer piping located under or within 5 feet outside of proposed building limits and designated for abandonment shall be removed in its entirety.
- C. Sewer piping located more than 5 feet from proposed building limits and designated for abandonment shall be either removed in its entirety or filled with a controlled low strength fill having a minimum 28-day compressive strength of 50 psi and allowable bearing strength of 5,000 psf. Filling shall be accomplished by pumping the fill through existing structures or ends of the existing sewers.
- D. Unless otherwise shown on the plans, sanitary piping designated for abandonment and located more than 5 feet outside the proposed building limits shall be capped and plugged and abandoned in place. Refer to plans for removals.
- E. Structures located under or within 5 feet outside of proposed building limits shall be removed in their entirety. As a minimum, all other structures designated for abandonment shall be removed to within 3 feet of the proposed finished grade and filled with controlled density fill.
- F. Septic tank shall be abandoned in accordance with the Niagara County Sanitary Code Article IIA, Section 569-25: "For safety purposes, all abandoned septic tanks shall be crushed, removed, or filled with stone, earth, or sand."

3.10 MAINTENANCE OF SEWAGE FLOWS

- A. Sewage flows from upstream sewers and laterals shall be maintained without interruption during the life of the Contract. Any method for bypassing sewage flows shall be submitted in writing to the Architect/Engineer for approval prior to start of bypassing. Included in the submittal shall be the following:
 - 1. A sketch and description indicating:
 - a) The method for any plugging of sewers and location of same
 - b) Pumps and bypass pump – location, size and pump capacity
 - 2. Method of handling flows after working hours
 - 3. Method of testing newly installed sewers
 - 4. Any alternative or back-up measures for handling sewage flows
- B. In the event that the Contractor's temporary modification to the sewer system, or service laterals for maintenance of sewer service, results in any damage to public or private property, the Contractor shall repair the damage including cleaning of basements where sewage has backed up, as directed by the Architect/Engineer, at the Contractor's expense.

3.11 FIELD QUALITY CONTROL

- A. In the presence of the Owner's Designated Representative, inspect each length of pipe and each structure delivered to the job for flaws, cracks, dimensional tolerance and compliance with the applicable specifications. Only pipes, fittings, and structures accepted by the Owner's Designated Representative and so marked shall be installed in the work.

- B. The Contractor shall inspect pipe joints and verify that they have been properly installed and made up, and free from sags, high spots, and excessive deflections.
- C. The Owner's Designated Representative shall inspect each stretch of completed pipeline and structure prior to backfilling, to insure compliance with the Contract Documents. The Contractor shall not continue with backfilling operations prior to inspection by the Owner's Designated Representative, utility representatives or prior to recording as built information.
- D. Afford Architect/Engineer access to the work so that he may spot check the installations or check each length of pipe immediately after it has been installed, or check it at any time after installation.
- E. Contractor shall request Owner's Designated Representative inspection prior to and immediately after placing aggregate cover over pipe.
- F. Upon completion of construction of the sanitary sewer, including trench backfill, the Contractor shall clean and flush all pipes. The system shall be left free of all stones, sand, silt, or mortar projects. The benches and inverts of manholes and bottoms of inlets shall have all mortar dropping chipped away to leave a smooth, clean surface.
- G. All materials flushed from the storm sewer shall be intercepted and removed to prevent the materials from entering the existing sanitary sewer system.

3.12 DAMAGED FACILITIES

- A. Any section of piping that is found defective in material, alignment, grade, joint, or otherwise, shall be corrected at no additional cost to the Owner.
- B. In the event that dirt, debris, or any other foreign material has entered any portion of the piping or structures, flush the piping or structure with clean water. Continue the flushing process until the piping or structure is clean, as determined by the Architect/Engineer.
- C. Any damage done to existing utility mains or their appurtenances as a result of work under this contract shall be repaired or replaced by the Contractor to the satisfaction of the Architect/Engineer at no additional cost to the Owner.

END OF SECTION 333116

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Extent of storm sewer system work includes, but is not limited to the following:
1. Furnish and install storm sewer drainage and under drain piping, fittings, and accessories
- B. Contractor shall be responsible to maintain flow through existing storm sewer systems by whatever means necessary, including pumping, temporary piping etc. Contractor shall coordinate with the Architect/Engineer for approval of proposed methods.
- C. Related Sections:
1. Division 31 Section "**Earth Moving**"
 2. Division 32 Section "**Turf and Grasses**"

1.3 QUALITY ASSURANCE

- A. All precast concrete sections and structures, and all castings shall each be the product of a single manufacturer who can furnish evidence of satisfactory experience in the product of high quality products of the type indicated and specified.
- B. Pipe and pipe fittings shall be produced in a plant of recognized reputation that is regularly engaged in the production of pipe conforming to the specified standards. Pipe and pipe fittings of the same type shall be the product of a single manufacturer.
- C. All pipe and pipe fittings, structures, and castings shall be of good quality and free from defects which would make it unfit for the use intended.
- D. Contractor shall be responsible for furnishing all labor, materials, surveying instruments and tools necessary to establish and maintain all lines and grades.

1.4 SUBMITTALS

- A. Submit manufacturer's data and shop drawings for precast structures, frames and covers, coatings, pipe connectors, backwater check valves, etc.
- B. Manufacturer's certifications of compliance for precast concrete sections and castings shall be

submitted.

- C. Manufacturer's literature and catalog cuts including technical, material specifications, dimensions, tolerances, and installation information for all underdrain products, pipe and pipe fittings, and geotextile fabrics.
- D. Submit a 1 foot-long sample of the Type 1 Corrugated HDPE Underdrain product with fabric for approval.
- E. Shop drawings, catalog cuts, and manufacturer's literature for all pipe and pipe fittings, to include coatings and linings, material specifications, dimensions, tolerances, and all related data shall be submitted.
- F. Manufacturer's certification that pipe supplied meets the required specifications shall be submitted.
- G. Pipe manufacturers shall furnish Certificates of Compliance on pipe, with each load of pipe supplied. Immediately turn certificates over the Architect/Engineer. Materials delivered to the site without accompanying certificates will be subject to rejection.
- H. Submit record drawings indicating actual location of pipe runs, connections, wyes, stubs, structures and associated invert elevations. Record actual vertical separations at all exposed utility crossings. Record invert elevations at all utility crossings.
- I. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Each length of pipe delivered to the site shall be clearly marked at the factory with the name of the manufacturer, class of pipe, pipe diameter and all else as required by the codes, standards, and specifications referred to under this section. Omission of this information will be cause for rejection of pipe.
- B. Store all materials in accordance with manufacturer's approved instructions. Store all materials so they can be easily inspected and so they will not be damaged prior to installation.
- C. Carefully handle all pipes and fittings when loading and unloading to avoid damage to pipe, coatings, or linings. Pipe or fittings with damaged coatings or linings shall be repaired or replaced by the Contractor at his expense and to the satisfaction of the Architect/Engineer. Lift pipes and fittings by hoists or lower on skid ways in a manner to avoid shock. Lower pipe into trench with derricks, rope, or suitable equipment for the safety and protection of workmen, materials, equipment, property, and the work.
- D. Do not dump or drop pipe and fittings. Those that are dumped or dropped are subject to rejection by Architect/Engineer.

- E. Carefully handle precast sections and all castings when loading and unloading to avoid damage. In the event of damage, either in delivery or installation, the damaged section shall be immediately removed from the project site and replaced at no additional cost to the Owner.

1.6 ABBREVIATIONS

CIP	Cast Iron Pipe
CMP	Corrugated Metal Pipe
CPP	Corrugated Polyethylene Pipe
DIP	Ductile Iron Pipe
PVC	Polyvinyl Chloride Pipe
PCPP	Perforated Corrugated Polyethylene Drain Pipe
RCP	Reinforced Concrete Pipe
SICPP	Smooth Interior Corrugated Polyethylene Pipe

1.7 MATERIAL TESTS

- A. Various tests and checks shall be performed, as specified herein, to determine compliance with the specifications and drawings. The Contractor is advised that failure of a test is suitable grounds for the Architect/Engineer to order that portion of the work removed and reconstructed, if necessary, to meet the requirements of the Contract Documents.

1.8 JOB CONDITIONS

- A. The drawings indicate the required structure and pipe sizes, and locations of all structures, piping and appurtenances. Verify all locations and immediately notify Architect/Engineer of any discrepancies or conflicts.
- B. Contractor shall verify that survey benchmark and intended elevations for the work are as indicated. Contractor shall verify existing site conditions.
- C. Utilities shown on the Contract Drawings are for the convenience of the Contractor, exact locations are not guaranteed. The Contractor shall verify existing utilities with the proper authorities.
- D. The Contractor shall take precautions to protect from harm the work of other contractors on site, existing facilities, as well as adjacent property. The Contractor shall be responsible for all damage or injury done to pipes, structures, utilities, pavement, buildings, property or person as a result of work to complete this contract. The Contractor at his own expense shall repair or replace such property or item to the satisfaction of the property owner, utility owner, public agency having jurisdiction, Architect/Engineer and Owner's Designated Representative.

1.9 PROTECTION OF WATER AND GAS LINES FROM STORM SEWER

- A. Parallel Water (or Gas) and Sewer Lines – Potable water (or gas) lines and pipelines carrying sewage, (including vaults, manholes or structures) shall not be installed any closer than 10 feet

- horizontally from one another. The distance shall be measured outside edge to outside edge of pipe or structure.
- B. **Water (or Gas) and Sewer Line Crossings** – Whenever water (or gas) and sewer lines must cross, the sewer must be situated below the water (or gas) line with at least an 18-inch clear, vertical separation between top of sewer line and bottom of water line. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water (or gas) line joints (at least one full laying length of water (or gas) pipe shall be centered over the sewer). In no case shall a water (or gas) line pass under a sewer unless specifically approved by the Architect/Engineer. Where a water (or gas) line is approved to cross under a sewer, adequate structural support (compacted select fill) shall be provided for the sewer to prevent excessive deflection of joints and settling of the sewer on the water (or gas) line.
- C. **Special Conditions** – When it is not practical to maintain a 10-foot horizontal separation between sewer and water (or gas) lines, immediately notify the Architect/Engineer. If the Architect/Engineer concurs, the utilities shall be installed as follows:
1. For water (or gas) lines that pass over sewers: the water (or gas) line shall be installed as far away from the sewer as possible with a minimum horizontal separation of 3 feet and a minimum of 6-inches above the sewer, as measured from the invert of the water (or gas) line to the crown of the sewer.
 2. For water (or gas) lines installed below sewers: the water (or gas) line shall be installed 18-inches below the invert of the sewer or by one of the following as approved by the Architect/Engineer with a variance obtained from the appropriate Department of Health office:
 - a. Construct the sewer using water main standard pipe and testing said pipe at 150 psi, or
 - b. Encase, sleeve, or otherwise envelope the water main or sewer to maximize protection of the water main.
- D. **Special Conditions – Crossing Lines** – When it is impossible to obtain proper vertical separation, immediately notify the Architect/Engineer. If the Architect/Engineer concurs, the utilities shall be installed as follows:
1. For water (or gas) lines that pass over sewers: If 18-inches of vertical separation is not feasible and the vertical separation is between 6- and 18-inches, all water (or gas) line joints within 20 feet of the sewer shall be encased in control density fill.
 2. For water (or gas) line that pass below sewers: If 18-inches of vertical separation is not feasible one of the following shall be completed as approved by the Architect/Engineer with a variance obtained from the appropriate Department of Health office:
 - a. Construct the sewer using water main standard pipe and testing said pipe at 150 psi, or
 - b. Encase, sleeve, or otherwise envelope the water main or sewer for a distance equal to two full lengths of water pipe to maximize separation between the crossing and unprotected joint.

PART 2 – PRODUCTS AND MATERIAL

2.1 GENERAL

- A. Caps and Plugs – Water tight, of similar manufacturer and producing the same joint conditions as the pipe on which the cap or plug is placed.
- A. Foundation Materials:
 - 1. Gravel or crushed stone bedding shall be as detailed on the Contract Drawings and as specified in Division 31 Section “Earth Moving”.
 - 2. Select earth backfill shall be as detailed on the Contract Drawings and as specified in Division 31 Section “Earth Moving”.
- B. Pipe Adapters – Join pipes of different materials with adapters specifically manufactured for that purpose and as approved by the Architect/Engineer. Where dissimilar materials join, such that galvanic action may produce corrosion, provide dielectric couplings to preclude damage to the materials.
- C. Concrete for Pipe Encasements and Cradles – Class A concrete per NYSDOT Standard Specification Section 501.

2.2 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE (SICPP)

- A. Corrugated polyethylene pipe storm sewers shall be high-density corrugated polyethylene smooth interior pipe. Four-inch to 10-inch diameter pipe shall conform to AASHTO M252 with the addition of smooth interior and 12-inch to 36-inch diameter pipe shall conform to AASHTO M294, Type S. Material compounds shall conform to ASTM D3350. Pipe shall be Hi-Q as manufactured by Hancor, N-12 as manufactured by Advance Drainage Systems, Inc., or approved equal.
- B. Pipe joints and fittings shall be of the same material as the pipe.

2.3 PERFORATED CORRUGATED POLYETHYLENE UNDERDRAIN PIPE (PCPP)

- A. Perforated corrugated polyethylene drain pipe 4 inches through 10 inches in diameter shall be flexible high density corrugated polyethylene, corrugated on the inside and outside conforming to AASHTO M252 except that tubing manufactured from material meeting ASTM D1248, Class B shall also be acceptable. Pipe shall be heavy-duty AASHTO pipe as manufactured by Hancor, or approved equal.
- B. Perforated corrugated polyethylene tubing and fittings 12 inches and 15 inches diameter shall meet the requirements of AASHTO M292 Type CP.
- C. Pipe joints and fittings shall be of the same material as the pipe.
- D. The geotextile fabric around the under drain shall be Mirafi 140N as manufactured by Mirafi, or approved equal.

- E. The underdrain filter stone shall be as specified in Division 31 Section “Earth Moving”.

2.4 CONNECTIONS TO EXISTING PIPE LINES

- A. Provide connections where shown on the Contract Drawings. Where no details of the connections are shown, submit a proposal for approval, showing fittings, adapters, and procedures used.

2.5 DETECTABLE UNDERGROUND MARKING TAPE

- A. For all PVC, CPP, SICPP, or DIP sewer pipe or laterals, provide detectable warning tape. Refer to Division 31 Section “Earth Moving”.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Thoroughly clean interiors of pipes, fittings, and appurtenances, joint surfaces, and gaskets prior to installation. Maintain pipes and fittings clean.
- B. Verify that excavation is in the proper location, that pipes and structures have been installed at the correct elevations, and that the subgrade has been properly prepared.

3.2 PIPE AND STRUCTURE INSTALLATION - GENERAL

- A. Trenching and related excavation work shall be completed in accordance with Division 31 Section “Earth Moving” and in a manner as approved by the Architect/Engineer. Remove all boulders, organic or spongy material, and other deleterious matter. Verify that trench excavation is ready to receive work and that excavations, dimensions, and elevations are as indicated on drawings.

Remove large stones or other hard matter, which could damage piping or impede consistent backfilling or compaction.

- B. Pipe Foundation: All pipes, fittings, or specials to be installed shall be properly bedded in uniformly supported on pipe foundations of the type specified in Division 31 Section “Earth Moving” and indicated on the Contract Drawings.
- C. Firmly bed pipe in the required depth of aggregate in such a manner that the pipe barrel is uniformly supported and cradled throughout its length. Provide suitable depressions where required in the foundation material to permit adequate bedding of the bells or other projections. The total depth of bedding shall be constant across the trench width.
- D. Install storm structures and pipelines to the required lines and grades indicated on the drawings, or as directed by the Architect Engineer using an approved method of control.
- E. Carefully lower pipes, fittings, and structures into the trench. Apply joint lubricant (if required) in accordance with the approved manufacturer’s recommendations. Join pipe sections and fittings. Join pipe and structures.

- F. Select pipe and fittings so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. Pipe and fittings, which do not fit together to form a tight fitting joint, are not permitted.
 - G. Use only mechanical cutters for cutting pipe.
 - H. Cut ends of pipe which terminate at catch basins, manholes, or other structures cleanly and trim to a neat, sheared edge, flush with the inside wall of the structure.
 - I. Maintain cleanliness of installed pipe, fittings, and structure interiors throughout the work. Plug ends when installation is not in progress so that dirt, foreign matter, water, animals, and people do not enter the work. Drainage of construction excavations through installed pipes shall not be permitted.
 - J. Maintain the excavation free of water during the progress of the work. No pipes or structures shall be laid in water nor shall there be any joints made up in water. No separate allowance for pumping or otherwise removing water will be made. All slides or cave-ins of the trenches or cuts shall be remedied at the expense of the Contractor, and to the satisfaction of the Architect/Engineer.
- 3.3 ADJUSTMENT OF CATCH BASINS TO FINISHED GRADE
- A. Adjustment of catch basins shall be completed as specified in Division 33 Section "Precast Manholes" and as shown on the drawings.
- 3.4 CLEAN OUTS
- A. Clean outs shall be installed in accordance with the Division 22 Section "Facility Sanitary Sewer" and as shown on the Contract Drawings.
- 3.5 FIELD QUALITY CONTROL
- A. In the presence of the Owner's Designated Representative, inspect each length of pipe and each structure delivered to the job for flaws, cracks, dimensional tolerance and compliance with the applicable specifications. Only pipes, fittings, and structures accepted by the Owner's Designated Representative and so marked shall be installed in the work.
 - B. The Contractor shall inspect pipe joints and verify that they have been properly installed and made up, and free from sags, high spots, and excessive deflections.
 - C. The Owner's Designated Representative shall inspect each stretch of completed pipeline and structure prior to backfilling, to insure compliance with the Contract Documents. The Contractor shall not continue with backfilling operations prior to inspection by the Owner's Designated Representative, utility representatives or prior to recording as built information.
 - D. Afford Architect/Engineer access to the work so that he may spot check the installations or check each length of pipe immediately after it has been installed, or check it at any time after installation.

- E. Contractor shall request Owner's Designated Representative inspection prior to and immediately after placing aggregate cover over pipe.
- F. Upon completion of construction of the storm sewer, including trench backfill, the Contractor shall clean and flush all pipes. The system shall be left free of all stones, sand, silt, or mortar projects. The benches and inverts of manholes and bottoms of inlets shall have all mortar dropping chipped away to leave a smooth, clean surface.
- G. All materials flushed from the storm sewer shall be intercepted and removed to prevent the materials from entering the existing storm sewer system.

3.6 DAMAGED FACILITIES

- A. Any section of piping that is found defective in material, alignment, grade, joint, or otherwise, shall be corrected at no additional cost to the Owner.
- B. In the event that dirt, debris, or any other foreign material has entered any portion of the piping or structures, flush the piping or structure with clean water. Continue the flushing process until the piping or structure is clean, as determined by Architect/Engineer.
- C. Any damage done to existing utility mains or their appurtenances as a result of work under this Contract shall be repaired or replaced by the Contractor to the satisfaction of the Architect/Engineer at no additional cost to the Owner.

END OF SECTION 334100